AUSTRALASIAN EVOLUTION SOCIETY

DEAKIN UNIVERSITY AUSTRALIA Worldly

CENTRE FOR INTEGRATIVE ECOLOGY

Geelong Botanic Gardens

30 Sep – 2 Oct 2013

IUSSI AUSTRALASIAN SECTION

Table of Contents

Conference Overview

	Monday, 30 Sept	Tuesday, 1 Oct		Wednesday, 2 Oct	
	Auditorium	***Auditorium***	***Acacia Room***	***Auditorium***	***Acacia Room***
8:00	**Registration & coffee**				
9:20	Welcome				
9:30	**Plenary 1:** *David Raubenheimer*	**Plenary 2:** *Naomi Langmore*		**Plenary 3:** *Sonia Kleindorfer*	
10:30	Non-genetic Inheritance	Behavioural Ecology 1		Evolutionary Ecology 3	Phylogenetics
11:00	**MORNING TEA**	**MORNING TEA**		**MORNING TEA**	
11:30	Understanding Diversity	Social Evolution	Evolutionary Ecology 2	Behavioural Ecology 2	Molecular Evolution
13:00	**LUNCH**	**LUNCH**		**LUNCH**	
14:00	Sexual Selection 1	Sexual Selection 2	Signalling	Cognitive Evolution	Life History
15:30	**AFTERNOON TEA**	**AFTERNOON TEA**		**AFTERNOON TEA**	
16:00	Evolutionary Ecology 1	Sex and Evolution		**Plenary 4:** *Charley Lineweaver*	
17:30	***Appetizers at E. Park Bowls Club***			***Buses depart for Barwon Edge Boathouse***	
18:00	Association Meeting ARC Funding Seminar			**CONFERENCE DINNER**	

Welcome

On behalf of the Australasian Evolution Society conference organizing committee, welcome to the AES 2013 conference!

Australia and New Zealand are blessed with enormous strength in the field of evolutionary biology, and that is reflected by the quality and diversity of presentations that we see at this conference. There are few meetings where one could hear about topics as varied as evolutionary responses to bushfires, navigation in swimming ants, sex-bias in love for video games, the origin of cancer, and the reliability of molecular clocks. There's certainly no opportunity to get bored.

Our evolutionary science community in Australasia is overwhelmingly collegiate and supportive about the science being done in our countries. With delegates from across Australia and New Zealand (and a few more international representatives from France and the UK), we have all the ingredients for an exciting and fascinating three days. We greatly appreciate your support and attendance at our biannual meeting.

As with our previous meeting in Townsville in 2011 we are delighted to be holding this meeting in conjunction with the Australasian Section of the International Union for the Study of Social Insects, and welcome the IUSSI members who are here. We are also fortunate to have received generous support from Deakin University's Centre for Integrative Ecology and from the Faculty of Science, Engineering and the Built Environment. I also thank the past president and vice-president of the society, Simon Robson and Megan Higgie, for their help, efforts and advice in the 'transfer of powers' to Deakin University. Finally I would also like to thank the enormous efforts of the current AES board and the members of the organizing committee, who have made the planning of this conference much more of a pleasure than I had the right to expect.

At a time when science appears to have become a dirty word (at least in Australia), it's great that we can spend these days reminding ourselves of the excellence of evolutionary research in our region. We hope that you enjoy everything Geelong and the Australasian Evolution Society 2013 meeting has to offer.

Matthew Symonds
President of the Australasian Evolution Society

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Mark Richardson
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General Information

Contributed Talks

There are numerous talks and we have a packed program, so it is essential that we keep to time. Your cooperation is sought in two main ways:

(1) **Upload your talk the day before your presentation** (or first thing Monday morning). Presentations can be uploaded at the "Presentation Upload" table, located just outside the Auditorium. Volunteers will assist with uploading presentations. Please be sure to:
- Name your file with ROOM, DAY, TIME, LAST NAME_FIRST
  Ex: "Auditorium Mon 1300 Smith_John"
- If you have video or audio clips, save your presentation and associated files in a single folder (named as above)
- Check your presentation before leaving the table

(2) **Please adhere to time limits**.
- Full talks = 12 min with an additional 2 minutes for questions.
- Short talks = 4 min with an additional 1 min for questions.

There will be a **visual cue** when you are nearing the end of your talk, and an **auditory cue** when you have reached your time limit.

Awards for Best Student Talks

To recognize outstanding student presentations, awards will be given to the top student presentations in each category (full-length and short). All students are eligible and will be assessed by a panel of judges. Prizes will be announced Wednesday afternoon, following the last plenary.

Association Meeting & ARC Funding Seminar

The association meeting will be held at the **Eastern Park Bowls Club**, which is located ~150 m west of the Conference Centre (see map at back of book). Finger-food will be provided, and a cash bar will be open for service.

Following the meeting, Mark Elgar will present a talk entitled "Selfish and altruistic strategies for ensuring success with the ARC."

Conference Dinner

The AES 2013 Conference Dinner will be held at the **Barwon Edge Boathouse** (40 Windsor Rd, Newtown).

Bus-transport will be provided to and from the Boathouse. At 5:30 pm on Wednesday, several buses will depart the Geelong Conference Centre for the Boathouse. Buses will make return trips to both the city centre and the conference centre at 11:00 pm and midnight.

Questions and Assistance

Conference volunteers and organizers will be wearing yellow name tags and are happy to assist you with any inquiries that you have.

Important Locations

*Also s*ee *maps at back of program.*

Registration	Geelong Conference Centre (GCC) Main Entrance
Contributed Talks	GCC Auditorium & Acacia Room
Tea breaks & Lunch	GCC Dining Room
Association Meeting	Eastern Park Bowling Club (~150m west of the GCC)
Conference Dinner	Barwon Edge Boathouse

Sponsors of AES 2013

Suggestions for Where to Eat & Drink in Geelong

**See map at:*
https://mapsengine.google.com/map/viewer?hl=en&mid=zJjdCN2ZtZ-E.kfU91JYLLXTM

PUBS & BARS (all serve food)				
Venue	***Address***	***Price range***	***Style***	***Comments***
***Elephant & Castle**	**158 McKillop St**	**$15 - 31 (bar) $23 - 34 (restaurant)**	**Bar food Australian**	**A few blocks from AGM Serve food until 8.30pm**
****The Edge**	**6 Eastern Beach Rd**	**$15 - 28**	**Australian, pizza**	**Serve food until 9pm Open until 10pm**
Carlton Hotel	21 Malop St	$13 - 18 (bar) $21 - 34 (restaurant)	Bar food Australian	Serve food until 8pm
The Sporting Globe	175 Ryrie St	$13 - 32	Sports bar	Mondays: 2 for 1 pizzas, wings & pots Tuesdays: $15 steak Serve food until 9pm

RESTAURANTS				
Venue	***Address***	***Price range***	***Style***	***Comments***
****The Wharf Shed Café**	**15 Eastern Beach Rd**	**$15-30 ($7.50 tapas)**	**Australian/ Italian/Tapas**	**On the waterfront Le Parisien (French restaurant) upstairs ($38-46)**
Khan Curry Hut	101 Ryrie St	$10 – 15	Indian	Open until 10pm
Shiraaz	48 Malop St	$13 - 22	Indian	Opposite Carlton Hotel Open until 10pm
Cocco Lounge	210 Ryrie St	$15 – 25	Licensed cafe	Opposite Sporting Globe
Oishii Japan	73 Yarra St	$25 - 32	Japanese	3 sushi rolls $16 Last ordersl 9pm
Black Bull	48 Moorabool St	$32 ($9 tapas)	Spanish/ Tapas	Tapas are $9 each
Baveras Brasserie	Cunningham Pier	$30 - 38	Australian	At the end of the pier
Customs House	57 Brougham St	$32 - 46	Australian/ Tapas/Wine bar	Next to The Edge (bar with food) Closed Monday
Fishermen's Pier	cnr Eastern Beach Rd & Yarra St	$32 - 45	Seafood	On the waterfront Winner 2011 Best Seafood Restaurant in Victoria

* ***Suggested venue for Monday evening***

** ***Suggested venues for Tuesday evening***

Schedule of Talks

Monday, 30 September — Auditorium

Plenary 1 (*Auditorium*) — Chair: *Andy Bennett*

9:20 **Matt Symonds**
Welcome

9:30 **David Raubenheimer**
Rethinking the nutritional phenotype

Non-genetic Inheritance (*Auditorium*) — Chair: *Vincent Careau*

10:30 **William Sherwin**
Darwin meets Lamarck and Mendel – evolutionary effects of transgenerational plasticity

10:45 **Angela Crean**
Like father like son? Nongenetic paternal effects revive the possibility of telegony

Understanding Diversity (*Auditorium*) — Chair: *Damian Dowling*

11:30 **Andy Bennett**
Redneck wonderland: the maintenance of diversity in a parrot species complex

11:45 **Madeleine Yewers ***
Male colour morphs of the tawny dragon lizard *Ctenophorus decresii*, a case of alternative mating strategies?

12:00 **Aidan Runagall-McNaull ***
The ecology of nongenetic inheritance in the neriid fly *Telostylinus angusticollis*

12:15 **Kristal Cain**
The role of ecology in shaping female competitive traits

12:30 **Benjamin Halliwell ***
The evolution of parental care in squamate reptiles: a comparative analysis

12:45 **Lára Hallsson**
The relative importance of genetic and nongenetic inheritance in relation to trait plasticity in *Callosobruchus maculatus*

12:51 **Louise Barnett ***
Is adaptive change facilitating the colonisation of natural environments by an invasive gecko?

12:57 **Ceridwen Boel ***
Hybrid morphology in south East Asian primates, and the implications for detecting hybrids in human evolution

Sexual Selection 1 (*Auditorium*) — Chair: *Keyne Munro*

14:00 **Megan Higgie**
Female preference evolution under experimental sympatry

14:15 **Barnaby Dixson**
Sexual selection and the evolution of men's secondary sexual traits

14:30 **Nikolai Tatarnic**
Surviving in sympatry: paragenital divergence and sexual mimicry between a pair of traumatically inseminating plant bugs

14:45 **Thomas White ***
The coevolution of iridescent visual signals and their behavioural presentation

15:00 **Megan Head**
Co-evolution of male and female genital morphology in the burying beetle, *Nicrophorus vespilloides*

15:15 **Amy Hooper ***
Sexual selection in the sea: males are indifferent to female quality in a cephalopod

15:21 **Kerry Fanson**
Is cryptic female choice decided by the race to the egg, or at the egg?

15:27 **Danielle Sulikowski**
Homosexual men show reduced sensitivity to cues of attractiveness in female faces

** Indicates student presentation*

Monday, 30 September — Auditorium

Evolutionary Ecology 1 (*Auditorium*) — Chair: *Angela Crean*

16:00 Alistair Senior
Exploring the evolutionary consequences of chemically disrupted sexual selection using an agent based model

16:15 William Feeney *
Aggressive mimicry in an adult brood parasitic bird

16:30 Erik Wapstra
Which snow skinks like it hot?

16:45 Lisa Schwanz
Temperature-dependent sex determination: can sex-specific age of maturity explain the evolution of sex-determining mechanisms in reptiles?

17:00 Melanie Massaro
Human-assisted spread of a maladaptive behaviour in a critically endangered bird

17:15 Kate Umbers
Triggers of startle display in an alpine katydid

17:21 Michelle Hall
Causes of animal personality in superb fairy-wrens

Association Meeting & ARC Funding Seminar — *Eastern Park Bowling Club*

18:00 Association Meeting

18:15 Mark Elgar
Selfish and altruistic strategies for ensuring success with the ARC

Plenary 2 (*Auditorium*) — Chair: ***Matt Symonds***

9:30 Naomi Langmore
Coevolutionary pathways: a tale of three cuckoos

Behavioural Ecology1 (*Auditorium*) — Chair: ***Matt Symonds***

10:30 John Endler
Visual tricks of great bowerbirds and their implications

10:45 Ben Oldroyd
Epigenetic inheritance of reproductive traits in inter-subspecies crosses of honey bees

Social Evolution (*Auditorium*) — Chair: ***Andrew Cockburn***

11:30 Lee Rollins
Spatial and temporal patterns of population viscosity in a cooperative breeder

11:45 Eunice Tan *
The evolution of polyspecific aggregation

12:00 Mathieu Lihoreau
Social foraging in drosophila

12:15 Mylene Mariette
Juvenile social experience affects pairing success at adulthood: congruence with the loser effect?

12:30 Michael Holmes *
Thelytokous production of queens by workers in the honeybee *Apis cerana*

12:45 Dany Zemeitat *
The evolution of cooperative communication in ant-butterfly associations

12:51 Bernadette Wittwer *
Evolution of communication: a comparison across the antennae of behaviourally diverse native bees

12:57 Simon Robson
Bridging and building: the dynamics of collective chain formation in green tree ants Oecophylla smaragdina

Sexual Selection 2 (*Auditorium*) — Chair: ***Megan Head***

14:00 Nadine Chapman
Is it all in the eyes? Sexiness in stalk-eyed flies

14:15 Amany Gouda-Vossos *
Sexism and the city: economic status, mate choice copying and sexual attractiveness

14:30 Geoffrey While
Sexual selection and the evolutionary implications of multiple introductions in an invasive lizard

14:45 Louise Allen *
Implicit and overt associations, and the judgmentalness of women

15:00 Darren Burke
The attractiveness of inverted faces

15:15 Gemma Cole *
Environmental effects on a multi-component signal

15:21 Zinnia Janif *
Does negative frequency dependence affect attractiveness in female hair colour and men's facial hair?

15:27 BriAnne Addison
Life ain't so ruff for Lola

Sex and Evolution (*Auditorium*) — Chair: ***Lisa Schwanz***

16:00 Joshua Christie *
Does within-individual genomic conflict explain the uniparental inheritance of mitochondria?

16:15 Luke Holman
Evolutionary consequences of knitting with one needle: the point of genomic imprinting

16:30 Jan Engelstädter
The evolution of natural transformation: costs and benefits of sex in bacteria

16:45 Madeleine Beekman
Uniparental inheritance, intragenomic conflict and mitochondrial diseases

17:00 Damian Dowling
Mitochondria, maternal inheritance and the evolution of male life histories

17:15 Nathan Burke *
Does sexual conflict maintain facultative parthenogenesis in the phasmatid *Extatosoma tiaratum*?

17:30 Fiona Ingleby
Sex-biased gene expression throughout development in *Drosophila melanogaster*

17:36 Yassaman Salehi-Alavi *
The evolutionary significance of facultative parthenogenesis in the Australian spiny leaf insect *Extatosoma tiaratum*

Evolutionary Ecology 2 (*Acacia*) — Chair: ***Kate Umbers***

11:30 Dominique Potvin
Burning love: a case study on the effects of intense bushfire on species hybridization and population genetics in the Litoria complex

11:45 Justin Eastwood *
Running rings around your host: first evidence of a virus 'ring species' and its role in host speciation

12:00 Aaron Davis
An adaptive fish family radiation in a depauperate continental fauna

12:15 Julie Collet
The measure and mismeasure of the Bateman's principles

12:30 Kelsey Hosking *
Where are all the hybrids? Understanding the determinants of hybridization and speciation in a frog hybrid zone

12:45 Jessica Evans *
Effects of nest microflora on avian immune function: observational and experimental approaches

12:51 Alice Pobjie *
Using molecular and traditional methods to characterize the microbial ecology of swallow and martin nests

12:57 Mark Richardson *
Population genetics of the invasive northern pacific seastar

Signalling (*Acacia*) — Chair: ***Mylene Mariette***

14:00 Ben Knott
Platycercus elegans: intraspecific variation in avian vision?

14:15 Qike Wang *
Deconstruct the soup-cuticular hydrocarbon signals of Australian meat ants

14:30 Claire McLean *
Concordance between phylogeographic structure and morph composition in a color polymorphic lizard

14:45 Jacqueline Sztepanacz *
Reduced genetic variance among high fitness individuals: inferring stabilizing selection on male sexual displays in *Drosophila serrata*

15:00 Alyssa Gibson *
Effects of litter size on development, sexual signalling and oxidative stress in wild mice

15:15 Elyshia Sheldon *
Song and non-song vocalisations of the great bowerbird with an emphasis on geographic variation

15:21 Laura Azzani *
Influence of diet on the odour profile of a New Zealand passerine

15:27 Milla Mihailova *
Olfactary signalling in a highly divergent species complex: the crimson rosella

Plenary 3 (*Auditorium*) — Chair: ***Kate Buchanan***

9:30 Sonia Kleindorfer
The role of sexual selection for species collapse and hybrid fitness in Darwin's finches

Evolutionary Ecology 3 (*Auditorium*) — Chair: ***Marianne Peso***

10:30 Adam Cardilini *
Morphological adaptation in the invasive European starling: cool birds and big beaks

10:45 Alicia Toon
Trait shifts correlate with environmental change: the evolutionary radiation of *Triodia*

10:51 Long Lee *
Indirect impact of air pollution on the seed beetle, *Callosobruchus maculatus*

10:57 Katherine Buchanan
Is vocal learning condition-dependent?

Behavioural Ecology 2 (*Auditorium*) — Chair: ***Erik Wapstra***

11:30 Andrew Kahn *
Paternity: why fish fathers care?

11:45 Mathew Berg
Keeping up appearances: stress, condition, and the unique plumage of parrots

12:00 James O'Hanlon *
First evidence for floral mimicry by a predatory insect

12:15 Vincent Careau
The quantitative genetics of a complex trait under directional selection

12:30 Raoul Ribot
Desert nomads: movement of black swans (*Cygnus atratus*) in arid Australia following La Niña floods

12:45 Andrew Katsis *
Can personality explain differences in songbird vocal learning?

12:51 Marianne Peso
Comparison shopping: detectability and mate preferences in a fiddler crab

12:57 Ondi Crino
Corticosterone exposure during development improves performance on a novel foraging task in zebra finches

Cognitive Evolution (*Auditorium*) — Chair: ***Rob Brooks***

14:00 Anthony O'Reilly *
Do swimming ants navigate with multiple odometers?

14:15 Mark Elgar
Cooperative competition in humans: influences of leadership and group attributes on specific outcomes

14:30 Tanya Latty
Phantom alternatives influence feeder preference in the eastern honey bee *Apis cerana*

14:45 Michael Kasumovic
For the love of violent video games: evolutionary insight into why men love them

15:00 Lisa Hodgkin *
Knowledge and leadership in *Perga affinis* sawfly larvae

15:15 James Makinson *
Collective decision-making during swarming in two open nesting honey bee species (*Apis dorsata* and *Apis florea*)

15:21 James Middleton *
The masculine undercurrents in the dark triad traits

15:27 Daniel Hoops *
The neural implications of sexual selection in agamid lizards

Plenary 4 (*Auditorium*) — Chair: ***Matt Symonds***

16:00 Charley Lineweaver
The planet of the apes fallacy, the origins of cancer and life on other planets

17:00 Lee Rollins
Presentation of student awards

17:10 Matt Symonds
Closing remarks

** Indicates student presentation*

Phylogenetics (*Acacia*) — Chair: ***Tanya Latty***

10:30 Sebastian Duchene *
Calibration placement and the reliability of molecular clocks

10:45 Robert Lanfear
Partitionfinder – model selection on genomic datasets made easy

10:51 Rebecca Laver *
Phylogeography of Kimberley geckos

10:57 Heroen Verbruggen
Evolution of the thermal niche and its impact on biodiversity patterns in seaweeds

Molecular Evolution (*Acacia*) — Chair: ***Alicia Toon***

11:30 Florencia Camus *
Examining the link between genotype and phenotype: mitochondrial gene expression levels across distinct haplotypes, sexes, and ages

11:45 Oliver Griffith *
Convergent use of genes in the evolution of placentation in amniotes

12:00 Frances Goudie *
Selection maintains heterozygosity at key genes in a clonal population of honey bees (*Apis mellifera capensis*)

12:15 David Duchene *
Rates of molecular evolution and diversification in plants: chloroplast substitution rates correlate with species-richness in the Proteaceae

12:30 Peter Smissen *
Relief for a 'splitting headache': resolving a rapid adaptive radiation in the endemic Australian *Pseudomys* species group (Muridae)

12:45 Emily Remnant
Interspecific mating between *Apis cerana* and *A. mellifera*

12:51 Wee Tek Tay
Tracing the origins of one- and two-leaf cape tulips in Australia

12:57 Kirstin Hanks-Thomson *
The evolution of *Pseudomonas aeruginosa* in the respiratory systems of people with cystic fibrosis

Life History (*Acacia*) — Chair: ***James O'Hanlon***

14:00 Erin Macartney *
Dietary, mating and age effects on male sperm quantity and testis size

14:15 Michael Garratt
Life-history constraints are exposed when genetically-modified mice compete with con-specifics

14:30 Magdalena Nystrand
Interacting effects of parental age and parent-offspring immune status on offspring performance

14:45 Moshiur Rahman *
Effects of polyunsaturated fatty acids on sexual traits in guppies

15:00 Jiahui Lim
A meta-analytic assessment of individual heterogeneity and a trade-off between two competing life-history traits within species

15:15 Tamara Johnson *
Larval population density and adult development in the gum-leaf skeletoniser moth, *Uraba lugens*

15:21 Benjamin Fanson
The role of differential acquisition for the evolution of sexual dimorphism in immune function

15:27 Jonathan Evans
Ova here mate: sperm 'smell' their way to genetically compatible eggs

Abstracts for Plenary Talks

RETHINKING THE NUTRITIONAL PHENOTYPE

David Raubenheimer

Charles Perkins Centre and Faculty of Veterinary Sciences and School of Biological Sciences, The University of Sydney, Sydney, NSW 2006, Australia

Successful nutrition results from the fine-tuned interactions within a tightly integrated network of behavioural, physiological, morphological and developmental traits. Despite the considerable progress that has been made in understanding each of these categories of traits separately, substantial challenges remain for understanding the integrated nutritional output that results from their interaction. This is a high priority in biology, because these systems-level outputs provide the crucial link between nutrition and most aspects of fitness, from growth and reproduction to predator avoidance and immune responses. Consequently, they provide a focus for understanding both the mechanisms through which nutrition influences animals and the adaptive diversification of nutritional strategies. I present a framework for defining and measuring such integrated nutritional phenotypes, which is based on the dynamic concept of homeostasis. I first show how the framework can be used to characterize nutritional phenotypes and their links to fitness in laboratory studies, and then address the question of whether the same approach can be applied in non-invasive studies of free-ranging wild animals. I close by demonstrating how the framework can help to understand instances where evolved nutritional strategies operate maladaptively in altered environments, using as illustration the relationship between human nutrition and the major global health problem of obesity.

COEVOLUTIONARY PATHWAYS: A TALE OF THREE CUCKOOS

Naomi E. Langmore[1], Rebecca M. Kilner[2], Will Feeney[1], Rob Heinsohn[3]

[1]*Research School of Biology, Australian National University*

[2]*Department of Zoology, University of Cambridge*

[3]*Fenner School of Environment and Society, Australian National University*

Cuckoos impose immense costs on their hosts, stimulating the evolution of host defences against parasitism. Host defences in turn select for counter-adaptations in cuckoos, giving rise to a coevolutionary arms race. However, these arms races take different forms; host species exhibit an impressive diversity of defence portfolios, and cuckoos exhibit an even more dazzling array of clever tricks to outwit host defences. I will discuss how different parasitism strategies of cuckoos can trigger different lines of defence in hosts, leading to divergent coevolutionary trajectories in cuckoo-host systems. Further, I will show how these dynamic interactions have implications for the evolution of social systems and speciation.

THE ROLE OF SEXUAL SELECTION FOR SPECIES COLLAPSE AND HYBRID FITNESS IN DARWIN'S FINCHES

Sonia Kleindorfer[1], Jody A. O'Connor[1], Rachael Y. Dudaniec[2], Steven A. Myers[1], Katharina J. Peters[1], Jeremy Robertson[1], Frank J. Sulloway[3]

[1]*Flinders University, School of Biological Sciences, GPO Box 2100, Adelaide, SA 5001, Australia*

[2]*Lund University, Department of Biology, Lund, Sweden 22100*

[3]*University of California, Institute of Personality and Social Research, 4125 Tolman Hall,*

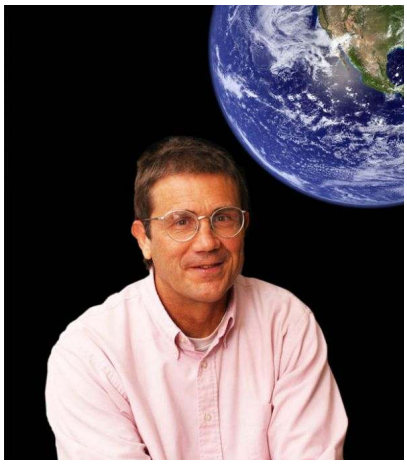
Berkeley, CA, 94720, USA

Recent observations of contemporary evolution are testimony to a mini-revolution in evolutionary ecology. The new paradigm that recognises rapid eco-evolutionary dynamics is now at the forefront of insights about the strength of selection and rates of evolution at local scales and in rapidly changing environments. Most studies using the contemporary eco-evolutionary framework have focused on the process of divergence, which is a key step in speciation. Today, I provide an example of recent species collapse via hybridisation. I ask: (1) What is the ecological context of the hybridisation? (2) What is the mechanism of the hybridisation? (3) What are the fitness benefits of the hybridisation?

The study uses morphological data on Darwin's finches collected in 1880/1906, historical song recordings from 1960s, and contemporary morphological, behavioural and song data from 2004 onwards. The field study was done on Floreana Island, Galápagos Archipelago and involves three purported sympatric Darwin tree finch species: small tree finch: *Camarhynchus parvulus*; medium tree finch: *C. pauper*; large tree finch: *C. psittacula*. In 1880/1906, there was model support for three morphological clusters (presumably three species). By 2000s, our morphological analysis showed three clusters in 2005, but only one cluster by 2010. Genetic analysis of microsatellite data from contemporary samples showed two genetic populations and one Hybrid cluster in both 2005 and 2010 with a shift in morphological space. In both years, hybrid birds were derived from Genetic Population 1 (small morph) and Genetic Population 2 (large morph).

The biggest ecological changes from 2005 to the present were changes in rainfall (prolonged drought from 2000 to 2007; high rainfall from 2008 onwards), and an associated increase in parasite intensity from the introduced parasitic fly *Philornis downsi*. The mechanism of the hybridisation was female choice by large rare females for small common males. Using song recordings, I calculate song quality per male using vocal deviation scores. Rare females paired more quickly with common males that sang high quality song, while males of any morph that produced low quality song remained unpaired. Thus, male quality was a more important driver for mate choice than male species. Hybrid nests had lower parasite intensity and higher fledging success than birds from Genetic Population 1 (small morph) or Genetic Population 2 (large morph). Future work needs to disentangle if the observed hybrid fitness was the result of parental care, novel genetic combinations, or immunological resistance (MHC diversity).

THE PLANET OF THE APES FALLACY, THE ORIGINS OF CANCER AND LIFE ON OTHER PLANETS



Charley Lineweaver

College of Physical and Mathematical Sciences, Australian National University, Canberra, ACT 0200, Australia

In the movie "Planet of the Apes" humans have been marginalized. Chimps, gorillas and orangutans inhabit the "intelligence niche". I will present neuro-paleontological and biogeographical evidence strongly suggesting that human-like intelligence is not a convergent feature of evolution on Earth or, a fortiori, on any other Earth-like planet. Thus, we should not expect to make contact with aliens with human-like intelligence. I will also argue that the most basic features of life on Earth are our best clues to the nature of extraterrestrial life. I will then present a new model for the origin of cancer. I will show how our new atavistic model depends on a more precise description of ontogeny and phylogeny, and is an improvement over the standard "somatic evolution model" of carcinogenesis.

ARC Funding Seminar

MONDAY, 30 September at 6:15 pm
Eastern Park Bowls Club

SELFISH AND ALTRUISTIC STRATEGIES FOR ENSURING SUCCESS WITH THE ARC

Mark Elgar

Department of Zoology, University of Melbourne, Melbourne, VIC, Australia

As a member of the ARC's College of Experts, Mark has a unique understanding of what makes ARC funding applications successful. Here, he will offer a 30-min seminar discussing different strategies that can lead to success with the ARC.

Abstracts for Contributed Talks

In alphabetical order by presenting author

LIFE AIN'T SO RUFF FOR LOLA

BriAnne Addison[1]*, George Lozano[2] , David Lank[3]

[1]*Centre for Integrative Ecology, Deakin University, 75 Pigdons Rd, Waurn Ponds, VIC, Australia*

[2]*Estonian Centre of Evolutionary Ecology, 15 Tähe Street, Tartu, Estonia*

[3]*Centre for Wildlife Ecology, Simon Fraser University, 8888 University Dr, Burnaby BC Canada*

**Currently: School of Science and Health, University of Western Sydney*

Males and females often have vastly different variances in reproductive success, selecting for different life history trajectories for the sexes. This famously links to different rates of aging for males and females, as well as differences in physiological phenotypes like stress. Recent syntheses of immunoecology give further motivation for the idea that males and females should differ in a number of physiological aspects of self-maintenance, including immune syndrome. Moreover in situations where several gender roles exist, such as in leks with multiple male roles, there may be selection for a range of immune syndromes within one species. Here we show that immune syndrome, and not just immunocompetence as a single variable measure, differs among the multiple gender roles in the Ruff (*Philomachus pugnax*), a leking shorebird with three distinct, genetically determined, male roles. As predicted by life history immunology, female mimics are immunologically more similar to females than to other male gender roles.

IMPLICIT AND OVERT ASSOCIATIONS, AND THE JUDGMENTALNESS OF WOMEN

Louise E. Allen[1], Barnaby Dixson[1], Rob Brooks[1]

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To introduce this topic I will begin with a review of the ways in which women compete with one another, and then discuss a study of how women and men judge and evaluate women. We studied the correlates of women's competitiveness and tendency to make implicit and explicit judgments of other women. Women and men are alike in their tendency to implicitly associate attractiveness with sexual virtue. There are, however, significant sex differences in how people explicitly judge images of women. In a word association task, women use more varied categories of words, whereas men use words pertaining to Attractiveness more frequently than Body Fat or Dress. Attractiveness is often likened to currency. This may be true for men, but women are possibly using the three categories equally to target the strengths or weaknesses of potential rivals. Dominant women tend to rate female bodies more harshly than other women do. Men showed no significant difference between dominance and harshness of ratings. It is possible that dominant women are cued for intrasexual competition, leading them to rate other women more harshly.

INFLUENCE OF DIET ON THE ODOUR PROFILE OF A NEW ZEALAND PASSERINE

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Behavioural research has recently focused on “odour signatures” in birds. For individual signatures to function in communication, and allow for individual identification, they need to be reasonably consistent over time, which would not be the case if they are readily modified by environmental factors, such as food intake. The major source of odour signatures in birds is the preen wax produced by the uropygial gland. However, there has been little biochemical investigation of the odour production process, and few experiments directly designed to test dietary influence on preen wax composition. Such information would serve to better understand differences in the odour of birds in different geographic areas, and the seasonal changes in preen wax composition reported for some birds, which may be influenced by seasonal changes in diet. Here we report findings from a diet supplementation experiment on wild free-living silvereyes *Zosterops lateralis*. Preen wax was collected from birds during four sequential phases of a feeding experiment, and analysed via gas chromatography. The resulting traces show that diet supplementation has a limited effect on preen wax composition in silvereyes, at least within the time frame considered in this experiment.

IS ADAPTIVE CHANGE FACILITATING THE COLONISATION OF NATURAL ENVIRONMENTS BY AN INVASIVE GECKO?

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Delays in range expansion are common following the introduction of invasive species. These lag periods may be caused by genetic constraints (e.g. founder effects and genetic bottlenecks), especially when adaptive change is necessary for exploitation of a novel habitat. Lags in range expansion are a major reason that invasion potential is under-estimated in introduced species. In Australia, the Asian house gecko (*Hemidactylus frenatus*) is the most successful invasive reptile. Since first establishing in Darwin approximately 60 years ago, this species has spread rapidly across tropical and subtropical areas via transportation networks. The Asian house gecko is widely considered to be a human-commensal, with a distribution that is strongly linked to human structures and settlements. However, increasing records of Asian house geckos in natural environments (often as high density populations) indicate a recent shift in habitat use at least in some areas. I investigate the evolution of differences in behavioural and morphological traits between urban and bushland Asian House geckos to assess whether adaptive change has facilitated the recent expansion of geckos into natural environments in Australia.

UNIPARENTAL INHERITANCE, INTRAGENOMIC CONFLICT AND MITOCHONDRIAL DISEASES

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Eukaryotic cells contain multiple mitochondria, so that each cell contains multiple genomes: mitochondrial genomes and a nuclear genome. Because mitochondria divide independently from the nucleus, the number of mitochondrial genomes within a single cell increases. Natural selection acts simultaneously within and among cells causing genetic conflicts. Selection within cells on mitochondrial genomes selects for fast replicating mitochondria, even if this is harmful to the cell. Selection among cells can then remove such cells, but such removal would not be to the advantage of the nuclear genome. One way to reduce selection for selfish mitochondrial genomes is to prevent the mixing of mitochondrial genomes from different individuals. Thus, during sexual reproduction only the mitochondria from one individual, mostly the mother, are transmitted to the offspring. However, this now raises a new set of problems. Because mitochondria present in males are basically 'stuck' in that they cannot be transmitted to the next generation, selection on mitochondrial function is expected to be relaxed in males. Here we investigate if the relaxation of selection on mitochondrial function in human males results in a higher prevalence of mitochondrial diseases in males relative to females.

REDNECK WONDERLAND: THE MAINTENANCE OF DIVERSITY IN A PARROT SPECIES COMPLEX

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Rare cases of ring species, or circular overlaps, offer an excellent opportunity to study speciation, because they can reveal how clinal variation across interbreeding populations may lead to reproductive isolation. In an 8+ year study across southern Australia we measured phenotypic traits among multiple populations, focusing on breeding pairs in two clinally varying populations to evaluate the contribution of assortative mating to population divergence. Highly variable yellow-red plumage, based on psittacofulvin pigments unique to parrots, has hitherto been the only trait used to define population, but we found no assortative mating for these pigmentary colours. We found that they were associated with climate, and was discordant with microsatellite variation, indicating a key role for selection in maintaining diversity. By contrast, the ultraviolet-blue coloration based on feather nanostructure, showed assortative mating in both populations, and varied geographically, but this variation was distinct from the pigmentary coloration. Our results suggest that structural coloration provides more significant sexual signals than pigmentary coloration in this parrot, and in parrots in general. The possible role of disease in maintaining variability in this species complex is also discussed, along with how our findings suggest refinements to Mayr's ring species hypothesis.

KEEPING UP APPEARANCES: STRESS, CONDITION, AND THE UNIQUE PLUMAGE OF PARROTS

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Recently, there has been growing interest in the possibility that stress influences ornamentation, and that glucocorticoid hormones may play a role in sexual selection. We tested the role of stress and glucocorticoids in mediating the condition dependence of plumage coloration. We report the findings from a dietary manipulation experiment and correlational data from a long-term field study of crimson rosellas (*Platycercus elegans*). Despite being amongst the most gaudy animals, the coloration of parrots has been relatively neglected and the adaptive significance of their coloration is not well understood. The crimson rosella complex exhibits striking variation in structural and pigmentary coloration, both within and between populations. We found that circulating corticosterone, the principal stress hormone in birds, was negatively correlated with body condition, and was higher in birds experimentally fed an energy-restricted diet. This effect was present in a measure of elevated corticosterone levels but not baseline levels. Structural coloration appears to be condition dependent in this species and involved in assortative mating, but we found little evidence for an association with corticosterone. However, the opposite was true for pigmentary coloration. Our results provide several new insights into the stress physiology and unique colour signalling system of parrots.

HYBRID MORPHOLOGY IN SOUTH EAST ASIAN PRIMATES, AND THE IMPLICATIONS FOR DETECTING HYBRIDS IN HUMAN EVOLUTION

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With the advancement of genetic research techniques and the sequencing of archaic hominid genomes, the possibility of hybridization in human evolution is once again under consideration. However, limitations on the techniques and the limited availability of fossils mean that genetic research can't be our only avenue of investigation. The application of a complimentary morphological approach has often proven to be problematic. Despite a number of claims being made over decades of research, there are no widely accepted examples of hybridization in the human fossil record. Generally citing unusual combinations of modern and archaic features, claims are difficult to test - and the fact is that we have very little idea of what a hybrid in the human lineage would actually look like.

Using 3D morphometrics and select non-metric characters, this study investigates the manifestation of hybridization in primate populations in South East Asia. Early work focusses on Chinese *Macaca,* which are well documented in range, morphology and genetics, and have indications of supraspecific gene flow over an extended period of evolutionary time. The preliminary results are compared to research of similar intent conducted on African primates, and the implications for the possibility of identifying hybrids in human evolution are considered.

IS VOCAL LEARNING CONDITION-DEPENDENT?

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Complex songs are hypothesized to have evolved in songbirds as a result of selection through female choice. As developmental stress is known to affect both song complexity and neural development, females choosing males with complex songs are thought to be making a choice for male quality. However, it is not known whether the well documented effects of early developmental stress on song complexity are due to the effects directly on song learning or the motor control of song production. We sought to test whether vocal learning *per se* is dependent on developmental conditions. Nestling zebra finches were reared under either developmental stress (food restriction) or control conditions between days 5-30 post-hatch. Their ability to recognise their father's song was tested at day 80 posthatch by quantifying immediate early gene expression (ZENK and ARC) in the brain of male offspring in response to father's song playback or the playback of the song from a novel male. Individuals exposed to food stress grew more slowly, although showed compensatory growth in later life. The data test the importance of developmental conditions for song learning in this model species.

THE ATTRACTIVENESS OF INVERTED FACES

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People are highly sensitive to configural variation in faces. This sensitivity allows for discrimination between different identities and detection of facial expressions and is reduced when faces are inverted. The extent to which configural sensitivity facilitates judgements of facial attractiveness is not well understood, but is the focus of the current study. Across two experiments, we manipulated several featural and configural cues to attractiveness (including pupil size, skin tone, lip fullness, symmetry, and sexual dimorphism) of male and female faces and asked participants to make judgements of attractiveness of these faces when presented upright as well as inverted. Our data suggest that reduced sensitivity to configural cues in inverted faces does hinder people's ability to make appropriate attractiveness judgements. This confirms mate-choice judgements as a potential selection pressure in the evolution of hyper-sensitivity to facial configurations.

DOES SEXUAL CONFLICT MAINTAIN FACULTATIVE PARTHENOGENESIS IN THE PHASMATID *EXTATOSOMA TIARATUM?*

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The ubiquity of sexual reproduction in the animal kingdom is an evolutionary paradox. Due to the inherent genetic and ecological costs of sex, asexual lineages should theoretically outcompete and out-number their sexual counterparts, all else being equal. However, in nature, asexuality is rare while sex is common. Despite numerous attempts by evolutionists to explain this paradox, it is still unclear why obligate and facultative forms of asexuality are so underrepresented in animals. Nevertheless, recent mathematical modelling suggests that sexual conflict may account for the apparent rarity. We conducted laboratory experiments on the facultatively parthenogenetic Phasmatid, *Extatosoma tiaratum,* to empirically test the hypothesis that sexual conflict promotes the maintenance of parthenogenesis in facultative species. We measured reproductive output of parthenogenetic and sexual females after experimentally manipulating the presence of mates and the timing of mating onset. In addition, we assessed the success of female antagonistic behaviours and chemical defences in deterring and repelling males and in increasing the probability of parthenogenesis. Results from this research offer the first empirical evidence to support the hypothesis that parthenogenesis in facultative species is a conflict-selected trait.

THE ROLE OF ECOLOGY IN SHAPING FEMALE COMEPTITIVE TRAITS

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Weapons, ornaments, and agonistic behaviours are common in both sexes, but until recently most research has focused on the role of sexual selection in shaping male traits. In contrast, we know little about the ecological and evolutionary forces that shape the expression of these traits in females. The limited available data suggests that these traits are used to compete for access to limited reproductive resources. If so, variation in ecology is likely an important factor shaping the evolution of female competitive traits. However, the importance of resource availability in mediating female- competition or altering the consequences of variation in female competitive traits is currently unresolved. Here we explore the eco/evolutionary forces that influence female competition by contrasting two populations of superb fairy-wren (*Malurus cyaneus*) that differ in habitat quality and examining the relationships between resource availability, reproductive success, female competition and competitive trait expression. We found that when resources were limited, females had reduced reproductive success and responded more intensely to simulated competitors. We also found that relationships between competitive ability and reproductive success differed according to resource availability. We conclude that ecology likely plays an important role for determining the optimal level of competitive trait expression in females.

EXAMINING THE LINK BETWEEN GENOTYPE AND PHENOTYPE: MITOCHONDRIAL GENE EXPRESSION LEVELS ACROSS DISTINCT HAPLOTYPES, SEXES, AND AGES

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Mitochondria are key components of cellular metabolic processing, providing most of the cellular energy required for survival. The small set of genes located within the mitochondria has recently been the subject of much attention by evolutionary biologists, as a groundswell of studies have documented that allelic variance within the mitochondrial DNA (mtDNA) often confers modifications to the phenotype. Mitochondria have been shown to play an active role in the process of ageing, as already proposed by Harman in 1972, and recent studies suggest that some of this allelic variance is even male-specific. Here we use the fruit fly *Drosophila melanogaster* as a model to advance our understanding of the link between the mitochondrial genotype and phenotype. We sequenced full mitochondrial genomes of 13 lines and examine genotype-specific transcriptional profiles of 9 (out of 13) mitochondrial key genes on an isogenic nuclear background. Gene expression patterns are specifically examined for males and females and across two age classes. Our goal is to understand the elusive mechanisms that mediate mitochondrially-encoded effects on the phenotype, and to home in on the candidate mutations that cause these effects.

MORPHOLOGICAL ADAPTATION IN THE INVASIVE EUROPEAN STARLING: COOL BIRDS AND BIG BEAKS

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Allen's rule states that endotherms in hot climates will have larger appendages, relative to body size, than their counterparts in colder climates. Avian bills have been shown to conform to Allen's rule with larger bills acting as important thermoregulatory organs in hot environments. Evidence for this has largely come from interspecific studies across species that occupy distinct climatic environments over many generations. The invasive common starling, *Sturnus vulgaris* within Australia provides an excellent opportunity to evaluate the ability to conform to Allen's rule at the species level because occupies a wide range of climatic environments across its geographic distribution. Further, it has been present in Australia only for approximately 40 generations, allowing for estimation of the potential to adapt within this timeframe. We compared bill size, controlling for body size, of 914 starlings across a latitudinal gradient of 1,700 km and a maximum temperature cline of 10^{o}C within Australia. There was a significant effect of maximum temperature and latitude on the bill size of the common starling, with variation in bill size conforming to the expectations of Allen's rule (relatively smaller bills at higher latitudes). Our results suggest that invasive birds can rapidly develop morphological adaptations, which maximize metabolic efficiency.

THE QUANTITATIVE GENETICS OF A COMPLEX TRAIT UNDER DIRECTIONAL SELECTION

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Replicated selection experiments provide a powerful way to study how "multiple adaptive solutions" may lead to differences in the quantitative-genetic architecture of selected traits and whether this may translate into differences in the timing at which evolutionary limits are reached. We analyse data from 31 generations (*n*=17,988) of selection on voluntary wheel running in house mice. The rate of initial response, timing of selection limit, and height of the plateau varied significantly between sexes and among the four selected lines. Analyses of litter size and realized selection differentials seem to rule out counterposing natural selection as a cause of the selection limits. Animal-model analyses showed that although the additive genetic variance was significantly lower in selected than control lines, both before and after the limits, the decrease was not sufficient to explain the limits. Moreover, directional selection promoted a negative covariance between additive and maternal genetic variance over the first 10 generations. Data is also available on other traits that are genetically correlated with the selected trait, such as body mass and wheel running during the four days prior to selection. Hence, this long-term experiment can also provide insights into how the G-matrix is influenced by directional selection.

IS IT ALL IN THE EYES? SEXINESS IN STALK-EYED FLIES

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Stalk-eyed flies have their eyes located on the end of elongated stalks projecting laterally from their heads. In many species eyespan is exaggerated in males, and males with bigger eyespans win competitions over lekking sites and attract more females to their site. In the African stalk-eyed fly *Diasemopsis meigenii* females overtly reject prospective mates by prohibiting copulation and vigorously shaking their body to dislodge the male. Males with small eyes are more likely to be rejected than large males. To date most behavioural studies on stalk-eyed flies have focused on female response to male eyespan. In this study we controlled male eyespan to determine if other male morphological traits, behaviour or genetics influences rejection rates. We found that males of different genetic backgrounds vary in their attractiveness and that the size of a male's reproductive organs also influences his attractiveness. Additionally we identified several male behaviours associated both with courtship and whether or not a mating attempt would be accepted.

DOES WITHIN-INDIVIDUAL GENOMIC CONFLICT EXPLAIN THE UNIPARENTAL INHERITANCE OF MITOCHONDRIA?

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Why are the mitochondria of male gametes destroyed shortly after fertilisation? Theory predicts that within-individual genomic conflict is the answer. If a cell contains multiple mitochondrial lineages that differ in replication and respiration rates, within-cell selection should favour mitochondrial lineages that replicate quickly, while cell-level selection should prefer mitochondrial lineages that respire efficiently. 'Selfish' mitochondria increase replication rate at a cost to cell fitness, and thereby create a conflict between the mitochondrial and nuclear genomes. Uniparental inheritance is a nuclear-mediated mechanism that alleviates this theoretical conflict by preventing the mixing of, and competition between, different mitochondrial lineages. We use the acellular slime mould *Physarum polycephalum* to empirically test the above described 'conflict theory'. In *P. polycephalum,* nuclei and mitochondria replicate without cell division, creating an ideal environment for selection of selfish genomes. Nevertheless, evidence suggests that biparental inheritance can occur in certain crosses between specific *P. polycephalum* strains. This provides us with the opportunity to examine the fitness costs, if such costs exist, of the biparental inheritance of mitochondria. Here we present a mathematical model that explores the potential costs of biparental inheritance in *P. polycephalum,* as well as data comparing the fitness of different *P. polycephalum* strains.

ENVIRONMENTAL EFFECTS ON A MULTI-COMPONENT SIGNAL

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Sexual signals often comprise of several components that form an overall signal. The perception of such signals can change under different environmental conditions and each signal component may be affected by the environment differentially. Although many studies have looked at the effect of the environment on sexual signals, these studies have mainly focused on single trait components, rather than looking at suites of traits in combination. Additionally, studies that have investigated multiple component signals do not consider the environmental effects on these signals. Using the guppy *Poecilia reticulata* this study investigates the effect of water colour on the direction of evolution of a multi-component male colour signal. Our results suggest that the signals preferred by females are those which maximise overall colour contrast driving multivariate selection for the most conspicuous colour combinations in each environment.

THE MEASURE AND MISMEASURE OF THE BATEMAN'S PRINCIPLES

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The Bateman principles explain sexual dimorphism through sex-specific variance in mating (*M*) and reproductive success (*T*), and sex-specific relationships between *M* and *T* (Bateman gradients). Typically, males are considered to show more variance in *M* and *T* and the relationship between both (Bateman gradient) to be steeper, thus to undergo stronger sexual selection than females. Recent work challenges this paradigm by questioning the measurement and interpretation of the Bateman principles.

Here we show experimentally that in replicate groups of red junglefowl, *Gallus gallus*, variance was higher in male- rather than female *M* and *T* resulting in a steeper male Bateman gradient, as predicted by theory. However, we also reveal that current practices of inferring *M* indirectly from offspring parentage and of univariate regression of *T* over *M* massively bias estimates of Bateman gradients and sex-differences. Finally, we demonstrate that correlations between female *T* and *M* may emerge as spurious consequences of male preference for fecund females, indicating the need for experimental tests of Bateman gradients. While providing qualitative support for Bateman's principles, our study demonstrates how current approaches can yield biased and misleading results.

LIKE FATHER LIKE SON? NONGENETIC PATERNAL EFFECTS REVIVE THE POSSIBILITY OF TELEGONY

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Telegony is the hypothesis that offspring occasionally inherit characters from a previous mate of their mother. Although this seems unfeasible under Mendelian laws of inheritance, mounting empirical evidence for nongenetic inheritance mechanisms reinvigorate the hypothesis. In the neriid fly, *Telostylinus angusticollis*, fathers transmit their environmentally-acquired condition to offspring: large fathers that are reared on a high-quality larval diet produce larger offspring. Males show no obvious forms of paternal investment or care, and thus the mechanism mediating the effect of paternal condition on offspring body size is not known. As a first step towards disentangling whether the effect is borne by the sperm itself or by accessory-gland products (ACPs) in the seminal fluid, we mated females to a male in high/low condition, and then remated the female to a new male two weeks later. Interestingly, offspring size and viability were determined by the condition of the first male, with no effect of the condition of the second mate. Genetic tests confirm this result holds even when the second male is the biological father of the offspring. These findings suggest the paternal effect is mediated by ACPs, and provide a compelling case for reassessing the possibility of telegony as a valid phenomenon.

CORTICOSTERONE EXPOSURE DURING DEVELOPMENT IMPROVES PERFORMANCE ON A NOVEL FORAGING TASK IN ZEBRA FINCHES

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Exposure to developmental stress affects a range of phenotypic traits in later life history stages. For example, developmental stress affects learning broadly, but the direction of effect is not always consistent between studies. This disparity may arise from indirect effects of developmental stress on other physiological or behavioural systems, which can affect outcomes in learning paradigms. Here, we examine the effect of elevated corticosterone (the dominant avian stress hormone) during development on the ability of zebra finches to learn a novel foraging task as adults. Additionally, we evaluate treatment effects on metabolism and neophobia, to determine if these may indirectly alter learning results. We found that birds exposed to elevated corticosterone during development solved a novel foraging task faster than control siblings. This outcome could result from differences, not in learning ability, but in motivation for reward, or neophobic reaction to the testing apparatus. However, we found no difference between treatment groups in metabolic rate, and no differences in neophobic response to the apparatus. Hence, our data indicate that developmental stress can increase learning ability, and suggest that the effects of stress will vary based on the type of learning studied.

AN ADAPTIVE FISH FAMILY RADIATION IN A DEPAUPERATE CONTINENTAL FAUNA

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Australia's freshwater fish diversity is regarded as depauperate by global standards, with the majority of freshwater fishes apparently derived from marine families. Transitions across the marine-freshwater interface are widely regarded as key triggers for adaptive radiation of many aquatic clades around the world. Using the Australian terapontid fish family as a model system we identified significantly higher rates of phenotypic evolution in key dietary and morphological characters in freshwater species compared to marine counterparts. Moreover, there was significant correlation between several of these dietary and morphological characters, suggesting an underlying ecomorphological aspect to these greater rates of phenotypic evolution in freshwater clades. Australia's biogeographic history, that has precluded many of the major fish families that make up much global freshwater fish diversity, appears to have provided the requisite 'ecological opportunity' to facilitate the radiation of invading marine-derived fish clades.

SEXUAL SELECTION AND THE EVOLUTION OF MEN'S SECONDARY SEXUAL TRAITS

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Striking secondary sexual traits, such as brightly coloured "sexual skin," capes of hair, beards, and other facial adornments occur in adult males of many anthropoid primate species. In men facial shape, beards and body hair are highly sexually dimorphic, yet whether such masculine traits function as 'badges of status' or enhance sexual attractiveness to women, is strongly debated. I will present comparative data on ornamentation from 124 species representing 38 genera of New World monkeys, Old World monkeys and apes, including men, as they relate to mating systems, social structures and habitat types. I will then present findings from cross-cultural research on the role of facial masculinity, beards and body hair in women's perceptions of men's attractiveness. These findings will be used to better understand how male-male competition and female choice may have shaped the evolution of men's secondary sexual traits.

MITOCHONDRIA, MATERNAL INHERITANCE AND THE EVOLUTION OF MALE LIFE HISTORIES

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Maternal inheritance of mitochondria means that the mitochondrial DNA (mtDNA) reaches an evolutionary road-block in males. This implies that adaptation of animal mtDNA sequences will proceed chiefly through direct selection in females. Males should be able to rely on the female-specific adaptation of mtDNA to optimize their mitochondrial requirements for many traits. But, many metabolically-reliant traits are sexually dimorphic, and for these traits optimization of mitochondrial requirements for the female version of the trait might not result in optimized function in the male version. Mutations in the mtDNA that are maladaptive to males might thus accumulate within populations, if these same mutations are only slightly deleterious, benign or positive in their effects on females. This hypothesis is often called '*Mother's curse*', and the evolutionary process that facilitates it a '*sex-specific selective sieve*' in mitochondrial genome evolution. Here, I present research from our group, which provides the first direct experimental support for this evolutionary process. Our findings suggest that mitochondrial genomes are hotspots for the accumulation of mutations that affect the expression of core life history traits in males.

RATES OF MOLECULAR EVOLUTION AND DIVERSIFICATION IN PLANTS: CHLOROPLAST SUBSTITUTION RATES CORRELATE WITH SPECIES-RICHNESS IN THE PROTEACEAE

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Many factors have been identified as correlates of the rate of molecular evolution, such as body size and generation length. Analysis of many molecular phylogenies has also revealed correlations between substitution rates and clade size, suggesting a link between rates of molecular evolution and the process of diversification. In order to investigate how widespread this phenomenon is, we investigated patterns of substitution in chloroplast genomes of the diverse angiosperm family Proteaceae. We used DNA sequences from six chloroplast genes to test for a correlation between diversification and the rate of substitutions. Species-rich lineages of Proteaceae tend to have significantly higher chloroplast substitution rates, for both synonymous and non-synonymous substitutions. The link between the synonymous substitution rate and clade size is consistent with a role for the mutation rate of chloroplasts driving the speed of reproductive isolation. We find no significant differences in the ratio of non-synonymous to synonymous substitutions between lineages differing in net diversification rate, therefore we detect no signal of population size changes or alteration in selection pressures that might be causing this relationship.

CALIBRATION PLACEMENT AND THE RELIABILITY OF MOLECULAR CLOCKS

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The molecular clock is a powerful phylogenetic tool for estimating evolutionary timescales. Many studies rely on these estimates, in fields ranging from phylogeography to molecular epidemiology. One of the most successful applications of the molecular clock is modelling the spread of infectious disease, such as HIV and Influenza viruses in human populations.

In order to provide estimates of absolute timescales, molecular clocks need to be calibrated. A common method is to incorporate temporal information from fossils or biogeographic events, which can be used to fix the ages of one or more nodes in the phylogeny. The ages of other nodes can then be estimated by extrapolation.

The placement and number of calibrations can affect phylogenetic estimates of evolutionary timescales. However, actual evolutionary timescales are rarely known, which makes it difficult to compare the performance of different calibration strategies. We addressed this problem by conducting an extensive simulation study.

We found that the most accurate and precise molecular clock estimates are obtained with multiple calibrations or single calibrations at the root of the tree. Our results will provide a useful guide for future studies of evolutionary timescales using molecular clocks.

RUNNING RINGS AROUND YOUR HOST: FIRST EVIDENCE OF A VIRUS 'RING SPECIES' AND ITS ROLE IN HOST SPECIATION

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Identifying the forces responsible for population divergence is a rudimentary question in evolutionary biology. Parasites co-evolve with their hosts, and thus divergence in parasite populations may play a role in divergence of their hosts. However, the role of parasites in host speciation is poorly understood. We studied the prevalence and load of Beak and Feather Disease Virus (BFDV) in a circular overlapping host species complex (*Platycercus elegans*) in an eight year field study. We found that subspecies differed greatly in both virus prevalence and load. Surprisingly, hybrids and geographically intermediate subspecies were consistently found to have the lowest prevalence and load compared to their parental subspecies. Also, we demonstrate that younger birds and males are more likely to have a higher viral load, and that the prevalence of BFDV tends to fluctuate throughout the year. Phylogeographic analysis of the viral genome revealed that hybrids and intermediate subspecies share virus variants with one or both of the parental subspecies. The phylogeographic patterns in the virus were also consistent with Mayr's ring species concept. We discuss the implications of these findings for viral transmission and host speciation.

COOPERATIVE COMPETITION IN HUMANS: INFLUENCES OF LEADERSHIP AND GROUP ATTRIBUTES ON SPECIFIC OUTCOMES

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Leadership is ubiquitous in human societies, yet our understanding of the nature of successful leadership remains elusive. Contemporary evolutionary studies of human leadership highlight the distinction between leadership as a behavioural characteristic and leadership as a position within a social system. The so-called Big Man model reflects the former, and draws on perspectives of our ancestors' lifestyle to explain the prevalence, role and impact of physically large leaders. I evaluate this view drawing on data from the London 2012 Olympics and Paralympics. Comparison of the size and age of captains and others competing in team sports provides no support for the Big Man model: team captains were no taller than their team-mates, and teams with taller captains were no more successful. Nevertheless, team captains were consistently older than their teammates, and the frequency of serious infringements per game was negatively correlated with captain age. These data highlight the value of evaluating ideas from evolutionary psychology with field data from genuine human interactions. More practically, they suggest that the search for leadership qualities might be more profitably confined to those attributes that are likely to improve with age and/or experience.

VISUAL TRICKS OF GREAT BOWERBIRDS AND THEIR IMPLICATIONS

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Great Bowerbird males build a bower consisting of a metre-long avenue of sticks opening onto two courts which are made of gray objects. A female sits inside the avenue and watches a male display at the edge of the court. The male has arranged things so that she sees no coloured objects until he brings them into her field of view, and light-adapts her eyes so that green objects he presents are greener than if the avenue walls were not painted red. These tricks are more likely to hold the female's attention than actively being used in mate choice since there is little or no relationship between them and mating success, unlike the geometry of the courts themselves. Attention-holding has been neglected in studies of evolution of sexual signals.

THE EVOLUTION OF NATURAL TRANSFORMATION: COSTS AND BENEFITS OF SEX IN BACTERIA

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Bacteria engage in genetic recombination through a variety of mechanisms. One of these mechanisms is natural transformation, the uptake and incorporation of naked DNA from the environment. Although widespread in bacteria, the evolutionary benefit of transformation is still under debate. We present mathematical models exploring the evolution of natural transformation and its impact on adaptation in bacterial populations in different settings. These models incorporate a number of genetic and physiological costs and benefits of transformation that combined determine whether transformation is favoured or not. Benefits include an acceleration of adaptation through the Fisher-Muller effect and a direct nutritional benefit of the DNA that is taken up, whereas genetic costs may arise through breaking up beneficial combinations of alleles or the incorporation up of old, deleterious genes. Our models highlight the importance of stochastic effects in favouring natural transformation even in large populations of bacteria.

EFFECTS OF NEST MICROFLORA ON AVIAN IMMUNE FUNCTION: OBSERVATIONAL AND EXPERIMENTAL APPROACHES

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Bacterial communities are thought to have fundamental effects on the growth and development of nestling birds. However, very little is known about the microflora that routinely surrounds either nestling or adult birds in the wild or the impact these communities have on the avian immune response. To date, studies which have quantified natural avian bacterial communities, have not captured either the bacterial diversity or real abundance in their home environment, not have they tested effects on host immune function. From an ecoimmunological stand point, testing the impact of bacteria in the habitat of the host species is highly novel, but this is necessary for robust interpretation of the relationship between host immune function and the environment they occupy. With recent advances in sequencing technology, the ability to determine both bacterial diversity and abundance is now readily available. Here, we review what we know from studies to date and set some targets for testing relationships between bacterial communities and the immune function of wild and domestic zebra finches, with particular emphasis on these relationships across different climatic regions, seasons and life stages. Testing this will give a clearer understanding of immune function in wild birds and the spread and source of disease.

OVA HERE MATE: SPERM 'SMELL' THEIR WAY TO GENETICALLY COMPATIBLE EGGS

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I will report new data from mussels exploring the role that extracellular egg-derived fluids (sperm attractants) play in mediating gamete choice. One of my main objectives is to draw attention to the unique opportunities that these and other similar study models offer for expanding our understanding of how sperm and eggs interact prior to fertilization, and the subtle yet powerful influence that prezygotic egg-sperm signalling plays in sexual selection.

THE ROLE OF DIFFERENTIAL ACQUISITION FOR THE EVOLUTION OF SEXUAL DIMORPHISM IN IMMUNE FUNCTION

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Sexual dimorphism in immunocompetence is a taxonomically widespread pattern. Male animals often have reduced immune function compared to females. Research into the evolution of this pattern has focused on differential allocation of limited resources between immune function and reproductive strategies, with males allocating more resources away from immune function and towards reproductive effort. However, this resource allocation hypothesis assumes that females and males consume similar levels of resources, despite the observation that sexes often differ in resource intake. Here, we modelled optimal immune function for males and female when acquisition levels are plastic. We then empirically tested this model with the Queensland fruit flies. We show that acquisition can play an influential role in mediating sexual dimorphism in immunocompetence.

IS CRYPTIC FEMALE CHOICE DECIDED BY THE RACE TO THE EGG, OR AT THE EGG?

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Post-copulatory sexual selection is a powerful evolutionary force, but the underlying mechanisms are poorly understood. This study investigated whether sperm selection occurs along the reproductive tract (i.e., unfavourable sperm are prevented from reaching the egg), or whether sperm-egg interactions are the primary mediator of sperm selection (i.e., unfavourable sperm are prevented from fertilizing the egg). We bred genetically compatible and incompatible pairs of Gouldian finches (*Erythrura gouldiae*) and quantified the number of sperm that reached the egg. In two different experimental contexts (between and within females), we found no difference between compatible and incompatible pairs in the number of sperm trapped in the egg membrane. In contrast to the current view of cryptic female choice, this study suggests that the critical site of sperm selection is unlikely to be along the reproductive tract, but after the sperm has reached the egg.

AGGRESSIVE MIMICRY IN AN ADULT BROOD PARASITIC BIRD

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Avian obligate brood parasites foist the cost of parental care to their host, which selects for host defences. Hosts can defend against parasitism by, for example, rejecting foreign eggs or chicks, and these behaviours can be adjusted with their perceived risk of parasitism (i.e. the presence of adult parasites in the area). Consequently, adult brood parasites are generally under selection to evade detection by their host(s), and recent work has shown that this can be achieved by morphological mimicry of dangerous model (Batesian mimicry). However, an analogous outcome could be achieved by mimicry of a harmless model (Aggressive mimicry), as is done at later stages of the nesting cycle (e.g. egg, or chick mimicry). Here, we provide evidence that the brood parasitic African cuckoo finch females, *Anomalospiza imberbis*, are aggressive mimics of harmless southern red-bishop females, *Euplectes orix*; their tawny-flanked prinia hosts, *Prinia subflava*, are equally aggressive to the female cuckoo finches and bishops, and similarly decrease their egg rejection threshold after seeing either versus a male counterpart control. These data suggest that aggressive mimicry is a tactic that can assist brood parasites circumvent host defences at all stages of the host nesting cycle.

LIFE-HISTORY CONSTRAINTS ARE EXPOSED WHEN GENETICALLY-MODIFIED MICE COMPETE WITH CON-SPECIFICS

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An organism's investment in life history traits such as growth, reproduction and lifespan will be constrained by a variety of physiological factors. With regards to constraints on lifespan, genetic modification of gene expression has been successfully used to uncover some of the molecular pathways that influence how long an organism lives. These techniques have the potential to reveal constraints on other life history traits as I will demonstrate in this talk. We used a genetically-modified strain of mouse to test how various components of life history are constrained by oxidative stress, a physiological condition also implicated in ageing. Mice that did not express a key antioxidant enzyme used to protect against oxidative stress, copper-zinc superoxide dismutase (Sod1), showed altered investment in behavioural, morphological and molecular aspects of reproduction and sexual signalling. These effects were also found to be more prominent when animals were maintained in a competitive environment. We then used phenotypic manipulations to increase investment in various reproductive traits in both genetically-modified and wild-type animals. This allowed us to determine how oxidative stress, the outcome of this gene knockout, influences an organism's ability to increase metabolic rate, adjust mitochondrial function and limit further oxidative damage when investing in demanding periods of reproductive effort. Our results reveal that oxidative stress is one aspect of physiology that can directly reduce investment in reproduction. The examination of genetically modified animals in more ecologically-relevant conditions offers exciting opportunities to uncover the mechanistic constraints on life history evolution.

EFFECTS OF LITTER SIZE ON DEVELOPMENT, SEXUAL SIGNALLING AND OXIDATIVE STRESS IN WILD MICE

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The environment in which post-natal development occurs can have a substantial impact on the success of an individual. In mice (*Mus musculus domesticus*), pups from larger litters are often smaller and less developed at weaning than those from smaller litters. These smaller offspring increase their growth rate to "catch-up" in size to their peers by adulthood (compensatory growth). The consequences of compensatory growth can persist throughout life. I manipulated post-natal litter size of wild-derived mice to obtain small litter and large litter treatments that were weighed weekly from weaning age to adulthood. At weaning age, pups from larger litters were smaller and had an increased growth rate into adulthood than those from smaller litters, indicating compensatory growth. At weaning, a sub-sample of each treatment was also assessed for oxidative stress, a potential physiological consequence of compensatory growth that can lead to reduced reproductive success and decreased lifespan. The remaining male pups were assessed for scent marking rates weekly to test if sexual signalling behaviour trade-offs are associated with compensatory growth. In the current study, scent marking rates did not differ between treatment groups. Examining the effects of litter size provides a better understanding of mechanisms responsible for maintaining life-history traits.

SEXISM AND THE CITY: ECONOMIC STATUS, MATE CHOICE COPYING AND SEXUAL ATTRACTIVENESS

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'Mate choice copying' in humans can augment the attractiveness of men who are viewed alongside attractive women. But how much of this effect is due to an elevation in status rather than in some other component of attractiveness? And are the effects reciprocal between the sexes? To investigate this we used online surveys asking subjects to rate models (males and females) for attractiveness and earning capacity. Models were partnered with a same sex "friend", an opposite sex "partner" or "alone" (3 treatments). We found that all participants rated male targets with male "friends" as the highest earning, and "alone" as the lowest earning. Female targets with "partners" were rated as the lowest earning while female targets "alone" were rated as the highest earning. Treatment had no simple effect on attractiveness, although the model's age did. Attractiveness ratings decreased linearly with rising model age in both sexes. Status – in the form of estimated earnings - was not strongly coupled with attractiveness ratings, rising and then plateauing with model age. I will discuss the implications of these results for the idea that economic status enhances attractiveness and the role of sexual conflict in the evolution of sexism.

SELECTION MAINTAINS HETEROZYGOSITY AT KEY GENES IN A CLONAL POPULATION OF HONEY BEES (*APIS MELLIFERA CAPENSIS*)

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An asexual lineage that reproduces by automictic thelytokous parthenogenesis has a problem: rapid loss of heterozygosity resulting in effective inbreeding. This may contribute to the rarity of thelytoky, despite its theoretical benefits to females. Thus, the circumstances under which rare asexual lineages thrive provide valuable insights into the tradeoffs that have shaped the evolution of alternative reproductive strategies. A socially parasitic lineage of the Cape honey bee, *Apis mellifera capensis*, provides an example of such a lineage. It has been assumed that cytological adaptations slow loss of heterozygosity in this lineage. However, we present evidence supporting an alternative hypothesis: heterozygosity is largely maintained via selection against homozygous recombinants. We examined the genotype of the clonal population at closely linked microsatellite markers along Chromosomes III and IV, and identified regions in which heterozygosity is maintained. One such region contains the complementary sex-determining locus, at which homozygosity is lethal and so selection for heterozygosity is absolute. The observation of other regions on chromosomes III and IV where heterozygosity is maintained suggests that these regions contain functional genes that are deleterious when homozygous. Our results provide an explanation for the maintenance of heterozygosity at multiple loci in a thelytokous lineage.

CONVERGENT USE OF GENES IN THE EVOLUTION OF PLACENTATION IN AMNIOTES

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Placentae that provide substantial amounts of nutrients to embryos have evolved rarely in vertebrates. Placentae are formed by both maternal and embryonic tissue and can be classified by the tissues from which they are composed. The skink, *Pseudemoia entrecasteauxii*, possesses two placentae, including the chorioallantoic placenta and the yolk sac placenta. The function of each placenta has been inferred from their morphology, but genes that may control these functions are poorly known. We used next-generation sequencing to examine the transcriptome of the placental tissues of P. entrecasteauxii to compare gene expression patterns in the uterus of the chorioallantoic (n=3) and yolk sac placenta (n=3) of pregnant lizards and the uterus of non-pregnant individuals (n=2). Both the chorioallantoic and yolk sac placenta show substantial gene expression changes (3590 and 1457 differentially expressed genes compared to non-reproductive tissue respectively). There is a strong signal of convergent evolution in the differentially expressed genes that facilitate placental function in both *P. entrecasteauxii* and in mammals. Convergence of genes involved with placental function in lizards and mammals suggests genomic constraints on the evolution of placentation in vertebrates.

CAUSES OF ANIMAL PERSONALITY IN SUPERB FAIRY-WRENS

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Consistent individual differences in behaviour are evident in many animal species, but it is often not clear why individuals do not express the full range of behaviour seen in the population. One possibility is that limited behavioural flexibility is a consequence of constraints imposed by 'state' differences between individuals. Two key state differences are individual differences in genetic makeup and in early developmental conditions. We test the role of genetic differences between individuals in two of the main candidate genes related to personality in humans, the dopamine receptor gene (DRD4) and the serotonin transporter gene (SERT), in explaining behavioural differences between individual superb fairy-wrens. We also test whether individual differences in early developmental conditions underpin behavioural differences apparent later in life.

THE EVOLUTION OF PARENTAL CARE IN SQUAMATE REPTILES: A COMPARATIVE ANALYSIS

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Theory predicts that patterns of parental care within a species are the product of trade-offs between the benefits for offspring fitness and parental costs. Thus, differences in care between species arise from interspecific differences in ecology, life history, and/or phylogeny that mediate the value of benefit and cost functions involved in the trade-off. Studying the costs and benefits of care within a species is useful for inferring the causal relationships that maintain care states. However, to infer broader evolutionary patterns, comparative analyses of care traits across species are required.

Reptiles have traditionally been ignored in studies of the evolution of parental care, as parental care has often been assumed to be largely absent in this group. However, recent research has shown that squamate reptiles exhibit an array of parental behaviours from nest site choice, to the guarding of eggs and nests, to the tolerance of semi-independent juveniles within stable social groups. We used this data to address three key objectives; 1) to identify the divergence in key ecological, life-history or phylogenetic characteristics responsible for transitions between modes of care; 2) to elucidate the evolutionary pathways that have led to current diversity in squamate care; and 3) to shed light on the evolutionary constraints prohibiting the emergence of more sophisticated modes of care in reptiles, such as parental provisioning. To achieve this, we categorised species based on their expression of distinct modes of care and conduct comparative analyses within an eco-phylogenetic framework to establish common factors in the emergence of care modes. We show that both life-history and ecology are important in transitions to parental care but in different ways for different parental care traits. We discuss these results within the context of the causal factors that have resulted in the emergence of parental care across taxa.

THE RELATIVE IMPORTANCE OF GENETIC AND NONGENETIC INHERITANCE IN RELATION TO TRAIT PLASTICITY IN *CALLOSOBRUCHUS MACULATUS*

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A trait's response to natural selection will reflect the nature of the inheritance mechanisms that mediate the transmission of variation across generations. The relative importance of genetic and nongenetic mechanisms of inheritance is predicted to be related to the degree of trait plasticity, with nongenetic inheritance playing a greater role in the cross-generational transmission of more plastic traits. However, this prediction has never been tested. We investigated the influence of genetic effects and nongenetic parental effects in two morphological traits differing in degree of plasticity by manipulating larval diet quality within a cross-generational split-brood experiment using the seed beetle *Callososbuchus maculatus*. In line with predictions, we found that the more plastic trait (elytron length) is strongly influenced by both maternal and paternal effects whereas genetic variance is undetectable. In contrast, the less plastic trait (first abdominal sternite length) is not influenced by parental effects but exhibits abundant genetic variance. Our findings support the hypothesis that environment-dependent parental effects may play a particularly important role in highly plastic traits and thereby affect the evolutionary response of such traits.

THE EVOLUTION OF *PSEUDOMONAS AERUGINOSA* IN THE RESPIRATORY SYSTEMS OF PEOPLE WITH CYSTIC FIBROSIS

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Pseudomonas aeruginosa (PA) is typically an opportunistic pathogen. Many PA infections are facilitated by mechanisms also used in the environment, but infections in the airways of cystic fibrosis (CF) patients can persist for many years, allowing time for the bacteria to adapt to the host. To study this adaptation process we have used Illumina HiSeq 2000 to sequence genomes of 80 isolates of PA collected longitudinally over up to four and a half years from seven CF patients. So far we have analysed the isolates from one patient. The six most recent isolates from this patient possessed a large (88 Kb) plasmid. The arrival of the plasmid coincides with the development of tobramycin resistance, potentially attributable to an aminoglycoside N(3')-acetyltransferase (*aac3*) gene on the plasmid. Fourteen of the fifteen isolates from this patient differed from each other by only 23 detectable single-nucleotide substitutions. Isolates with the plasmid appear to be descendants of earlier isolates without the plasmid. Previously, increased antibiotic resistance observed for PA during CF lung infection has been primarily attributed to changes in gene regulation or mutations in pre-existing genes. This study shows that acquisition of plasmids can facilitate PA adaptation to antibiotic exposure in the CF lung.

CO-EVOLUTION OF MALE AND FEMALE GENITAL MORPHOLOGY IN THE BURYING BEETLE, *NICROPHORUS VESPILLOIDES*

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Male genitalia are one of the fastest evolving and most variable morphological traits seen in many taxa. The size and shape of a male's genitals are important in ensuring fertilization of eggs within the female reproductive tract and thus this diversity is likely the result of sexual selection. Despite recognition of the role that sexual selection plays in driving the diversity of genitals, little is known about how male and female genitalia co-evolve. Here we investigate whether there is correlated evolution between male and female genitalia using burying beetles that have been artificially selected for high and low repeated mating rates. Repeated mating rate has previously found to be under sexually antagonistic selection in this species, thus our selection lines differ in the level of conflict between males and females. We found that both male and female genitalia evolved in response to selection regime. Furthermore, we found correlated evolution of male and female genitalia, with lines experiencing high sexual conflict showing greater divergence than lines experiencing low sexual conflict. Our results suggest that male and female genitalia in burying beetles evolve via sexually antagonistic co-evolution and that this process leads to rapid divergence of genitalia, thus explaining the great diversity seen in genital morphology.

FEMALE PREFERENCE EVOLUTION UNDER EXPERIMENTAL SYMPATRY

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Processes that affect the evolution of female preferences or male display traits in different populations have the potential to result in within-species divergence. This could occur via reinforcement of mate recognition in species using the same traits for species recognition and sexual selection. Sympatric individuals experience reinforcement of female preferences and male display traits, whereas allopatric individuals do not, creating the potential for divergent sexual selection in sympatric and allopatric populations. Sexual selection operates on the cuticular hydrocarbons (CHCs) of *Drosophila serrata*, and reinforcing selection also operates on the CHCs of populations sympatric with *D. birchii*. Using a selection experiment, where experimental sympatry was manipulated, we found evidence of divergence in female preference for male CHCs after 19 generations of selection. The combination of reinforcement and sexual selection can therefore generate divergence in female preferences and male display traits. These results have implications for the effect that species interactions may have on sexual selection and speciation.

KNOWLEDGE AND LEADERSHIP IN *PERGA AFFINIS* SAWFLY LARVAE

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Social insects, despite their characteristic cooperative behaviour and often high levels of relatedness, exhibit strong individual differences in behaviour. Larval aggregations of the Steel-blue sawfly *Perga affinis* are highly gregarious, and we have demonstrated that certain individual larvae 'lead' foraging trips more than expected by chance. In these larval colonies, unlike hierarchical societies, group consensus is shared and followers can choose whether to follow certain larvae. Here we investigate the role of individual knowledge of resources in the determination of *P. affinis* leaders. Research into other shared consensus societies, including humans and fish, has highlighted an important link between knowledge important for optimising group behaviour and the level of leadership displayed by individuals, allowing for the more informed individuals to lead or guide the uninformed majority. Using experimental manipulation of sawfly colonies and individual experience, we investigated how differential knowledge amongst individual *P. affinis* larvae influences decisions on who to follow. Our results provide empirical evidence that the familiarity of an individual with both its surroundings and its conspecifics plays an influential role in a larva's tendency to lead the colony. We therefore highlight the complexity of the emergence of leaders in a social insect society through shared decision making.

EVOLUTIONARY CONSEQUENCES OF KNITTING WITH ONE NEEDLE: THE POINT OF GENOMIC IMPRINTING

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Genomic imprinting refers to a pattern of gene expression in which a specific parent's allele is either under-expressed or completely silenced. Imprinting is an evolutionary conundrum because it appears to incur the costs of diploidy (e.g. presenting a larger target than haploidy to mutations) while foregoing its benefits (protection from harmful recessive mutations). I will introduce and synthesise the many hypothesised evolutionary costs and benefits of imprinting, and develop some new suggestions. I will also discuss the long-term evolutionary consequences of shutting off half of one's alleles at specific loci. Imprinting offers fascinating conceptual lessons on evolutionary conflict, the interaction between individual- and population-level fitness effects, and the "gene's-eye view" of evolution.

THELYTOKOUS PRODUCTION OF QUEENS BY WORKERS IN THE HONEYBEE *APIS CERANA*

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In a colony of eusocial insects, the queen is the only individual capable of sexual reproduction, while workers are all female and sterile. However, workers are capable of asexual reproduction. As a result of their haplo-diploid sex determination system, social insect workers can typically only produce male offspring (arrhenotokous parthenogenesis) as they cannot fertilize their eggs. However, in some species, workers are able to asexually produce diploid, female offspring (thelytokous parthenogenesis). Thelytoky has been demonstrated in 51 social insect taxa. Amongst honeybees, thelytoky is only known to regularly occur in the Cape honeybee, *Apis mellifera capensis*.

We observed continuous production of queen cells in hopelessly queenless colonies of the Asian hive bee, *Apis cerana*. Microsatellite analysis revealed that at least two of the queen cell contents could not have been the daughter of the previous queen. Moreover, their genotypes were compatible with being worker-produced. Thus, we demonstrate that at least in some cases, *A. cerana* queens may be thelytokously produced by workers. We then removed queens from four *A. cerana* colonies and collected all the queen cells produced in the subsequent month. Microsatellite analysis will reveal the extent to which *A. cerana* queens are produced by workers rather than queens.

SEXUAL SELECTION IN THE SEA: MALES ARE INDIFFERENT TO FEMALE QUALITY IN A CEPHALOPOD

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It is well demonstrated that prudent investment of mating resources by males will be selected for where there are significant mating costs, and females vary significantly in reproductive value. Although it may be relatively simple to establish that some mating opportunities may be more profitable that others, it is also important to consider how individuals might strategically maximize reproductive investment over multiple matings, where mating resources are limited and value of future matings is uncertain, though this remains poorly studied. We aimed to determine if male bottle tail squid, *Sepiadarium austrinum,* adjusted their reproductive investment in females of different quality in response to the quality of a previously encountered female. Males were sequentially mated with two females of different size: a large then a small female; or a small then a large female. Contrary to expectations, males did not strategically allocate more sperm to higher quality females. Instead, mating investment was determined by mating order, with second mated females receiving fewer spermatophores. Our results demonstrate that selection for male choice can be hindered by low mate availability, even where males stand to gain significant reproductive benefits from prudent choice.

THE NEURAL IMPLICATIONS OF SEXUAL SELECTION IN AGAMID LIZARDS

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Size and colour are frequently subject to sex-specific sexual selection, with males often larger and more colourful than females. But can this selection also influence brain development? The role of sexual selection in altering brain organisation and structure over evolutionary time is very poorly understood. Behaviour and motivation are strongly influenced by sexual selection and therefore the neural systems underlying these sexually selected traits must also be under intense sexual selection pressure. *Ctenophorus* lizards vary in their level of sexual dimorphism from monomorphic, inconspicuous species to highly ornamented (colourful) males. In this study we use this sexual dimorphism as a proxy for the intensity of sexual selection and ask: do dimorphic species invest more heavily in brain regions associated with reproduction and sexual behaviours? We compare the brains of individuals from different species that have different levels of sexual dimorphism, using both MRIs and fluorescent Nissl staining. We found that males from sexually dimorphic species have a larger pre-optic area of the hypothalamus, which is associated with male sexual behaviour. In contrast, males from monomorphic species have larger ventro-medial hypothalami, a region that is associated with female sexual behaviour and feeding motivation. In the habenula, a control brain region, there was no difference between sexually dimorphic and monomorphic males. Our results suggest that like colouration, size, shape, and behaviour, sex-specific selection pressures can indeed influence brain development.

WHERE ARE ALL THE HYBRIDS? UNDERSTANDING THE DETERMINANTS OF HYBRIDIZATION AND SPECIATION IN A FROG HYBRID ZONE

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Green-eyed tree-frogs, *Litoria serrata/Litoria myola*, are stream-breeding hylid frogs endemic to rainforest in the Wet Tropics region of North Queensland. *Litoria serrata* is comprised of two genetically distinct lineages (N and S) reflecting long-term geographic isolation to northern and southern rainforest refugia during the Pliocene and Pleistocene epochs. The two lineages were brought into secondary contact in the central Wet Tropics when rainforest expansion reconnected refugia approximately 6,500 years ago. Previous research has shown the contact zone to be a mosaic consisting of the main contact (A) and contact B involving a recent geographical isolate of the southern lineage (*Litoria myola*) within the range of the northern lineage. Hybrid individuals occur at both contacts and artificial crosses have revealed that hybridization is only possible in one direction (N female x S male). However, the amount of hybridization occurring and the types of hybrids involved have not been determined. Using genetic and morphological techniques, I have estimated hybrid status and 'fitness' of tadpoles through both contact zones to determine levels of hybridization and success of hybrids at this important life stage. I compared these results to data on hybrid adult frogs through the contacts. This project will determine whether postzygotic isolation is limiting hybridization between the lineages and its importance in driving speciation.

SEX-BIASED GENE EXPRESSION THROUGHOUT DEVELOPMENT IN *DROSOPHILA MELANOGASTER*

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As most of the genome is shared between males and females, sex-biased gene expression is thought to underlie much of the sexual dimorphism observed in nature. When fitness optima differ between sexes for a shared trait, sexual dimorphism can allow each sex to express their optimum trait phenotype, and in this way sex-biased gene expression could help to resolve intralocus sexual conflict. However, very little is known about how sex-biased gene expression relates to sex-specific fitness. I present the results of a preliminary experiment examining genome-wide sex-biased gene expression throughout development in *D. melanogaster*. I show that there is extensive evidence of sex-biased gene expression that increases throughout development, and that most sex-biased genes are male-biased. I then compare these patterns of sex-biased gene expression to genes that have been previously identified as being under sexual conflict in *D. melanogaster*. Finally, I describe ongoing research that will test the association between sex-biased gene expression and sex-specific fitness throughout development within a quantitative genetic framework. This will provide insight into the sex-specific genetic architecture of gene expression and whether sex-biased gene expression could evolve to resolve sexual conflicts.

DOES NEGATIVE FREQUENCY DEPENDENCE AFFECT ATTRACTIVENESS IN FEMALE HAIR COLOUR AND MEN'S FACIAL HAIR?

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Frequency-dependent selection may maintain or erode genetic diversity within populations. Animal studies show that both negative frequency-dependent selection for rare or novel traits and positive frequency-dependent selection for familiar traits can occur. However, frequency-dependent attractiveness judgments of human traits have not been extensively studied. We tested for frequency-dependent attractiveness judgments on two traits that show marked within-population variability and are known to significantly impact perceptions of sexual attractiveness: women's hair colour and men's facial hair. We found no effect of frequency on preferences for hair colour in women. Strong sex differences in preferences were, however, exhibited. Men preferred blondes and women preferred brunettes, and neither sex preferred red hair. We observed negative frequency-dependence in preferences for men's facial hair. When fully bearded or clean-shaven faces were rare they were considered more attractive than when they were common. This indicates that negative-frequency dependence may maintain some of the variety in male facial hirsuteness and grooming styles, but might not be as important in the maintenance of variation in hair colour in women.

LARVAL POPULATION DENSITY AND ADULT DEVELOPMENT IN THE GUM-LEAF SKELETONISER MOTH, *URABA LUGENS*

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Population density may have profound effects on male and female reproductive success. For example, locating a mate may be less challenging in high-density environments, but there may be more intense pre- and post-mating competition for fertilisation success. In contrast, locating a mate may be more challenging in low-density environments, but competition may be less intense. For insects, information about their larval social environment may be used to predict their adult environment. Several studies reveal that insects adjust their allocation of resources to growth in key adult functions according to the larval density experienced, thereby increasing reproductive success. Accordingly, we explored the effects of larval density on investment in the gum-leaf skeletoniser moth *Uraba lugens*. We found that adult males reared at lower densities developed larger wings and antennae. This may increase the males chances of locating a mate by improving his flight ability and increasing his sensitivity to the female sex pheromone. When males were reared at higher densities, suggesting higher levels of sperm competition, they developed larger testes. This research provides further evidence of trade-offs in resource allocation during development. In addition, it demonstrates how population density may influence the sexual communication system of moths through selection on receiver structures.

PATERNITY: WHY FISH FATHERS CARE?

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In most taxa, females are the sole providers of parental care. Why are males so lazy? Evidence suggests that it's partly the fault of females: multiple mating and uncertainty of paternity hamper the evolution of male care. But what if fathers can actually increase their share of paternity by caring? Here we show that this idea provides a novel explanation for why male-only care is so much more common in fish than other groups. In our model, post-mating 'paternity protection' provides an extra incentive for males to stay with their young after mating. If offspring survive better when guarded, this paternity bonus is enough to kick-start the evolution of male-only parental care from a no-care scenario.

FOR THE LOVE OF VIOLENT VIDEO GAMES: EVOLUTIONARY INSIGHT INTO WHY MEN LOVE THEM

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Video games are awesome. Since their first introduction to a mass-consumer market in the mid-80's, they have become the highest grossing form of entertainment in history. Along with this change in popularity is a change in the demographics of players; what began as a young male dominated interest is now a past time that is equally appreciated by both sexes of all ages. There still, however, exists an average difference in the game preferences of either sex: females prefer word and puzzle games, while males prefer violent, action games. Left- and right- brained theories fall short of explaining these differences since they largely ignore the variance in the distribution of game preferences of either sex. We use a more evolutionary approach to try and explain the variance around sex-specific differences in game preferences. Here I discuss how individual biological responses to violent and non-violent video games affect subsequent abilities to recognize emotional changes and potentially threatening conspecifics, and how this may translate to fitness benefits. To foster discussion in my new evolutionary venture, I'll buy a beer for the first three students interested in discussing the intersection of video games and evolution.

CAN PERSONALITY EXPLAIN DIFFERENCES IN SONGBIRD VOCAL LEARNING?

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Songbirds show intraspecific variation in vocal learning ability, for reasons that remain poorly understood. One possible theory is that differences in personality may account for some of this variation. My study investigated whether superb fairy-wrens (*Malurus cyaneus*) of certain behavioural types are more proficient at learning their parents' vocalisations. We separated genetic and social influences on vocal development using a cross-fostering experiment in a wild population, and later employed a "novel environment test" to quantify one aspect of offspring personality (exploration). We also recorded each bird's vocalisations – in particular a "contact call" used in social interactions – to analyse their acoustic properties. We predicted that the calls of cross-fostered birds would more closely resemble those of their foster rather than genetic parents, and that the degree of similarity would correlate with offspring personality.

PLATYCERCUS ELEGANS: INTRASPECIFIC VARIATION IN AVIAN VISION?

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The Australian parrot *Platycercus elegans* shows considerable intraspecific plumage colour variation across the species range, with subspecies showing three colour forms: crimson, yellow, and an intermediate *adelaidae* form. Currently, the factors driving and maintaining this diversity are unknown. However, sensory drive theories predict that differences in an animal's colour perception could drive the plumage variation observed within *P. elegans*, making the species an ideal potential candidate for intraspecific variation in the physiology of vision, hitherto unreported in birds. We studied the potential for short-term environmental variables and long-term evolutionary factors to cause such variation in *P. elegans*. For environmental factors, we studied the effects of dietary manipulations on the carotenoid-rich retinal oil droplets that strongly influence spectral sensitivity, and found diet caused complex changes in the absorbance of these droplets. For long term factors, we sequenced the protein opsins of the visual pigments from *P. elegans*. The low light sensitive rod visual pigments possessed an opsin extension unknown in any animal, and features of this could increase the acuity of low light vision. Differences in ambient light in which birds are active could cause adaptive changes in colour vision and, through sensory drive, lead to the divergence in plumage colour.

PARTITIONFINDER – MODEL SELECTION ON GENOMIC DATASETS MADE EASY

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Accurate phylogenetics relies on selecting appropriate partitioning schemes and models of molecular evolution. This is particularly important for genomic datasets that may contain thousands of loci for thousands of taxa. PartitionFinder is a piece of software that takes all the hard work out of selecting partitioning schemes and models of molecular evolution, and we have recently developed methods to extend PartitionFinder to work with genomic datasets. I'll describe how these new methods work, what they can do for you, and why you should care.

PHANTOM ALTERNATIVES INFLUENCE FEEDER PREFERENCE IN THE EASTERN HONEY BEE *APIS CERANA*

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Most models of human choice behaviour assume that unavailable options, such as a desirable product that's sold out, do not influence an individual's preferences for the remaining options. Experiments on human consumers, however, suggest that such 'phantom' alternatives can change, or even reverse, an individual's preferences. Is the phantom alternative effect unique to humans, or is it a general, taxonomically widespread phenomenon? Here we investigate the effect of attractive and unattractive phantom alternatives on the choice behaviour of the eastern honey bee, *Apis cerana*. Bees were presented with either a binary choice set containing two equally preferred feeder types ('the target' and 'the competitor'), or a trinary choice set containing the target, the competitor and one of the two phantoms. Just like human consumers, honey bees altered, and sometimes reversed their preferences when an attractive, but ultimately unavailable, item was added to their choice set. Our results suggest that the phantom alternative effect is taxonomically widespread and could consequently influence decision making in a wide variety of contexts such as mate choice and nest site selection.

PHYLOGEOGRAPHY OF KIMBERLEY GECKOS

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The vast and geographically complex Kimberley region is one of Australia's biodiversity hotspots and most understudied areas. The complex mosaic of arid zone savannah, isolated mountain ranges and mesic forest, combined with the extremely variable monsoonal climate has resulted in high levels of biodiversity and endemism. Recent work within the Kimberley has revealed severe underestimation of species diversity in a number of vertebrate groups, suggesting this region is home to numerous unrecognised endemic radiations, each comprising multiple species endemic to one or a few ranges. Using a number of gecko genera we are investigating how genetic diversity is patterned across the region and among species.

INDIRECT IMPACT OF AIR POLLUTION ON THE SEED BEETLE, *CALLOSOBRUCHUS MACULATUS*

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Current climate change is characterized by an increase in temperature as well as an increase in air pollution due to anthropogenic emissions. Both these environmental factors have great impact on living organisms such as insects. Previous studies suggest that the expected outcome of air pollution under the stress of climate change could cause a negative impact on crop yields. To date there are only a very few studies that focus on the indirect impact of air pollution within a changing environment on agricultural pest insects. I used the seed beetle *Callosobruchus maculatus* to experimentally test for the combined effects of climate change and air pollution. The results of this study should contribute to a greater understanding of the national and global issue of climate change which in turn could affect our environment and economy.

SOCIAL FORAGING IN DROSOPHILA

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Many of the social phenomena we observe in nature are organised around nutrient acquisition: animals often provision their young, aggregate on food patches and sometimes collectively cultivate their own crops. Paradoxically, however, the nutritional mechanisms driving these behaviours and their evolution are poorly understood. Based on concepts of nutritional ecology, we will discuss how the nutrient requirements of individual animals regulate a range of social behaviour, using the subsocial fruit fly *Drosophila melanogaster* as a model organism. We will illustrate how social attraction increases the speed and accuracy of flies' nutritional choices in controlled laboratory assays using chemically defined diets and automated tracking. We will describe how flies collectively balance their diet by synchronizing their foraging decisions, thus producing complex spatio-temporal group dynamics. Finally, we will demonstrate how agent-based models implementing basic principles of nutrition help exploring these collective behaviour and their adaptive values in various ecologically relevant environments. Our preliminary results in 'simple' insect groups provide a framework to further explore the impact of nutritional constraints on social evolution in a wider range of species and social systems.

A META-ANALYTIC ASSESSMENT OF INDIVIDUAL HETEROGENEITY AND A TRADE-OFF BETWEEN TWO COMPETING LIFE-HISTORY TRAITS WITHIN SPECIES

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A trade-off between offspring quality (i.e. size) and offspring number (i.e. maternal fecundity) is widely observed at the inter-specific level. Therefore, it is often expected that a reproductive trade-off between size and number of offspring will also be observed at the intra-specific level. A theoretical model, however, has suggested that instead of the negative correlations (trade-offs) between reproductive traits, positive correlations between traits can be observed within species. Most of the comparative synthesis done on this topic to date has focused on trade-offs at the inter-specific level or only within a single species. Here we present meta-analyses that test the magnitudes and directionalities of the general intra-specific correlation between offspring size and number in relation to maternal size across a wide range of species. From the relationships between maternal size to offspring size and number, the directionality of the trade-off between offspring size and number can also be indirectly inferred. In addition, a third meta-analysis was also conducted to directly test for the actual relationship between offspring size and number at the intra-specific level. Our results suggest that within species, positive associations between competing traits may be observed.

DIETARY, MATING AND AGE EFFECTS ON MALE SPERM QUANTITY AND TESTIS SIZE

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Subtle differences in environment can account for some of the phenotypic variation observable in wild populations. How an individual allocates resources to reproductive tissues versus somatic maintenance can also be affected by environment. Previously thought to occur mainly in females, the growing acknowledgement of the energetic costs of spermatogenesis may indicate that males are influenced by the same constraints. The neriid fly, *Telostylinus angusticollis* displays polyandrous mating behaviour with the males showing a high degree of condition dependence and phenotypic plasticity. However, it is unknown if this condition dependence extends as far as sperm traits and if reproductive age plays a role in some of the variation observable in the populations. I aim to test if two ecologically relevant environmental factors (diet quality and opportunity to mate) as well as reproductive age have an effect on sperm quantity and testis size. This will be done by use of experimental design in which males of *T. angusticollis* will be fed larval food of differing nutrient richness and adults will be contained in individual cages with adult diet and mating treatments. Testis size and sperm quantity will be measured at two week intervals from a subsample of males to test for effects of reproductive age.

COLLECTIVE DECISION-MAKING DURING SWARMING IN TWO OPEN NESTING HONEY BEE SPECIES (*APIS DORSATA* AND *APIS FLOREA*)

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The reproduction of honey bee colonies is a collective effort in which the queen, along with a few thousand workers, leaves the natal colony as a swarm to found a new nest. Upon leaving, the swarm settles in a temporary cluster and deliberates over where to go next. Scout bees search the surrounding habitat for suitable nesting locations before returning to the swarm and reaching a collective decision upon where to establish their new colony. In the case of the European hive bee (*Apis mellifera*) these scout bees are searching for cavities such as hollow logs, and spend many hours evaluating the potential nest sites before reaching a decision. But others from the 11 currently recognized honey bee species are not as slow in deliberating over nesting sites. Our research studying the process of reproductive swarming in the giant Asian honey bee (*A. dorsata*) and the red dwarf honey bee (*A. florea*), two open nesting species, has found that they go through a much simpler, and more rapid decision-making process than *A. mellifera*. Furthermore, the smaller *A. florea* appears to skip part of the decision-making process altogether, with swarms flying directly to their new home without forming a temporary cluster.

JUVENILE SOCIAL EXPERIENCE AFFECTS PAIRING SUCCESS AT ADULTHOOD: CONGRUENCE WITH THE LOSER EFFECT?

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Social interactions with adults are often critical for the development of normal mating behaviours. However, the potential role of other primary social partners such as juvenile counterparts is rarely considered. Most interestingly, it is not known whether interactions with juvenile females improve males' courtship and whether, similarly to the winner and loser effect in a fighting context, these interactions' outcome shapes males' behaviour in future mating encounters. We investigated the combined effects of male quality and juvenile social experience on mating and pairing success at adulthood in zebra finches (*Taeniopygia guttata*). We manipulated brood size to alter male quality and then placed males in either same- or mixed-sex juvenile dyads until adulthood. We found that males from reduced broods obtained more copulations and males from mixed-sex dyads had more complete courtships. Furthermore, independently of their quality, males that failed to pair with juvenile females, but not juvenile males, had a lower pairing success at adulthood. Our study shows that negative social experience with peers during adolescence may be a potent determinant of pairing success that can override the effects of early environmental conditions on male attractiveness. It thereby points towards the occurrence of a "bungler effect" in a mating context.

HUMAN-ASSISTED SPREAD OF A MALADAPTIVE BEHAVIOUR IN A CRITICALLY ENDANGERED BIRD

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Conservation often focuses on counteracting the adverse effects of human activities on threatened populations. However, conservation measures may unintentionally relax selection by allowing the `survival of the not-so fit'. Here, we report such a case in the endangered black robin (*Petroica traversi*) which, in 1980, was reduced to a single breeding pair. Following this bottleneck, some females were observed to lay eggs on the rims of their nests. Rim eggs always failed to hatch. To expedite population recovery, rim eggs were repositioned inside nests, yielding viable hatchlings. Repositioning resulted in rapid growth of the population, but by 1989 over 50% of all females were laying rim eggs. We used a species-wide pedigree to consider both recessive and dominant models of inheritance over all plausible founder genotype combinations. The pattern of rim laying is best fitted as an autosomal dominant Mendelian trait. We could also reject the null hypothesis of non-heritability in favour of our best fitting model of heritability. Data collected after intervention ceased shows that the frequency of rim laying has declined, and that this trait is maladaptive. This episode demonstrates that fixation of maladaptive traits could render small threatened populations completely dependent on humans for reproduction, irreversibly compromising the long-term viability of populations.

CONCORDANCE BETWEEN PHYLOGEOGRAPHIC STRUCTURE AND MORPH COMPOSITION IN A COLOR POLYMORPHIC LIZARD

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In polymorphic species, population divergence in morph composition and frequency has the potential to promote speciation. We assessed the relationship between geographic variation in colour polymorphism and genetic variation in the tawny dragon lizard, *Ctenophorus decresii*. We identified three genetically and phenotypically distinct lineages, corresponding to a ‘northern’ and ‘southern’ lineage within South Australia and a deeply divergent (at the interspecific level) New South Wales (‘NSW’) lineage. Four discrete morphs occurred throughout the ‘northern’ lineage and populations differed in the relative frequency of these morphs. Conversely, the ‘southern’ and ‘NSW’ lineages were both monomorphic but with different morph types. The degree of divergence between the ‘northern’ and ‘southern’ lineages was consistent with repeated isolation to multiple refugia during Pleistocene glacial cycles. As predicted, we detected a strong signature of population expansion, and low genetic diversity in the monomorphic ‘southern’ lineage relative to the polymorphic ‘northern’ lineage, consistent with loss of polymorphism during population contraction. We also identified a narrow contact zone with genotypic admixture between these lineages, yet no individuals of intermediate phenotype. Such evidence for pre- or post-zygotic barriers to gene flow between lineages that differ in morph composition supports a role for geographic variation in polymorphism in speciation.

THE MASCULINE UNDERCURRENTS IN THE DARK TRIAD TRAITS

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The Dark Triad traits (i.e., narcissism, psychopathy, and Machiavellianism) have been examined in relation to a number of interpersonal correlates like mating, social influence, and future-discounting. However, little has been done to examine the proximal psychological factors that might underlie these. In this study (*N* = 319), we envisioned the Dark Triad traits as a prototypically masculine way of dealing with the world and others. Indeed, prior research in Western and Eastern samples reveal men score higher than women do. We correlate the Dark Triad traits with an array of self-report measures of masculinity along with an indicator of prenatal testosterone during foetal development (the 2D:4D ratio). Beyond exploring these general links, we test whether between- and within-sex variability in scores on the Dark Triad traits can be accounted for by a latent masculinity index. The results of these analyses, and their implications, are discussed from an evolutionary perspective.

OLFACTARY SIGNALLING IN A HIGHLY DIVERGENT SPECIES COMPLEX: THE CRIMSON ROSELLA

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Recently there is growing evidence suggesting that birds use odour in several ecological contexts for a range of functions. Within Psittaciformes, only a handful of studies have investigated the role that olfaction might play in communication. The crimson rosella complex (*Platycercus elegans*) is a highly variable species, featuring subspecies that differ markedly in plumage coloration despite ongoing gene flow. It is unknown what mechanisms are involved in maintaining the extraordinary divergence within the complex. Crimson rosellas also produce a distinct and strong odour, which has never been investigated. Potentially, olfaction may be one important factor in the sympatric divergence occurring within the complex. Here, we used behavioural choice experiments in the lab and the field to test olfactory recognition. We found that crimson rosellas show a significant preference for their species-specific odour, suggesting that individuals can detect and respond to odours, and may use odours as signals for species and subspecies recognition. Additionally, we demonstrate the utility of gas chromatography mass spectrometry (GCMS), a little used technique for quantifying odour variation in birds. We use GCMS to show that crimson rosella individuals vary greatly in odour composition, and quantify odour differences between individuals and subspecies.

INTERACTING EFFECTS OF PARENTAL AGE AND PARENT-OFFSPRING IMMUNE STATUS ON OFFSPRING PERFORMANCE

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Immune systems vary in complexity due to both intrinsic factors and external factors (e.g. environment, pathogen). To understand the abundant variation that exists in immune defences, within and across organisms, it is necessary to address immunity from a life-history perspective. A key factor that has often been found to affect offspring performance in a range of animal systems is parental age. Another is maternal quality. Mothers can provide offspring, direct or indirectly, with resources that will facilitate in increasing offspring fitness. One of the most influential types of maternal effect is the transfer of immunity from mother to offspring. Maternal transfer of immunity is well established across a range of vertebrate systems, but evidence for trans-generational immune transfer in insect species is limited. In this study, we looked at the effects of parental immune status, age and offspring immune status on offspring performance in Drosophila melanogaster. We find several interactions between these parental and offspring factors, that affect the expression of offspring performance. Our results show that the expression of key offspring life histories is highly dynamic and influenced by cross-generational immune and age effects.

FIRST EVIDENCE FOR FLORAL MIMICRY BY A PREDATORY INSECT

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Mimicry theory is often regarded as one of the most significant advances in biological science since the description of evolution by natural selection. One of the major problems with our current understanding of mimetic relationships is that these resemblances are often noted based on our subjective human perceptions. One of the most infamous examples of this is the Malaysian orchid mantis, *Hymenopus coronatus*. For over a century this rare praying mantis has been renowned for its remarkable resemblance to a white flower blossom. Despite its popularity the hypothesis that this insect mimics a flower blossom to attract pollinators as prey has never been scientifically investigated. To test this hypothesis we conducted the first ever investigation into the morphology of the orchid mantis using the perspective of pollinating insects. We conducted the first ever investigation into the biology of the elusive orchid mantis. Using behavioural observations, physiological visual models and manipulate field studies we have shown for the first time that floral mimicry may actually function as a predatory strategy in the animal kingdom. This is a previously undescribed predatory strategy, and the orchid mantis may be the only floral mimic in the animal kingdom.

EPIGENETIC INHERITANCE OF REPRODUCTIVE TRAITS IN INTER-SUBSPECIES CROSSES OF HONEY BEES

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When two lines are crossed reciprocally the resulting progeny should have identical nuclear genomes and express similar phenotypes. Thus, if F_1 progeny differ depending on the sex of their parent, it may indicate that epigenetic effects are influencing phenotype. Epigenetic modification of phenotype depending on the parent-of-origin can be the result of reproductive conflict between the male- and female-derived parental genomes.

Apis mellifera capensis is a subspecies of honey bee from the Cape region of South Africa that is characterized by highly reproductive 'cheating' workers. *A. m scutellata* is subspecies in which workers are normally sterile. We created reciprocal crosses between the two subspecies using artificial insemination. We evaluated F_1 worker progeny for traits related to reproduction: 1) number of ovarioles; 2) weight; 3) presence of a spermatheca. (The spermatheca is a sperm storage organ of queens that is normally absent in workers.)

Workers with an *A. m. capensis* father had 30% more ovarioles than those with an *A. m. scutellata* father. Reciprocal effects were highly significant for weight and presence of a spermatheca, but were more strongly influenced by the rearing environment.

Our results suggest that *A. m. capensis* males make epigenetic modifications that enhance the reproductive potential of their worker offspring.

DO SWIMMING ANTS NAVIGATE WITH MULTIPLE ODOMETERS?

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For central place foraging animals (those that forage from and return to a central nest), knowledge of the location of the nest site at all times is vital. Many ant species maintain knowledge of their nest site through path integration, where foragers constantly update the direct direction and distance to their nest as they move around their world, by 'counting' the number of steps required to return to the colony. *Polyrhachis sokolova* inhabit mangroves in Northern Australia, which are frequently inundated by tidal sea water. We have demonstrated *P. sokolova* use path integration to relocate the colony when moving across dry land, and that they are capable of relocating the nest even if they are required to cross water to do so. These observations raise the question of how *P. sokolova* assess their distance from the colony when swimming rather than walking, as the relationship between stride length, gait and distance differs. We used standard techniques of animal navigation studies to confirm and quantify the mechanisms used by *P. sokolova* to navigate over terrestrial and water substrates. The detection of a second 'water-specific' model of navigation would represent an outstanding capability for a species with a relatively limited neural architecture.

COMPARISON SHOPPING: DETECTABILITY AND MATE PREFERENCES IN A FIDDLER CRAB

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Individuals of several species differentially direct their mate-seeking efforts dependent on whether they are presented with one or more potential mates. Using both one and two-choice mate choice experiments and manipulating release distance to the choice(s), we assessed the interplay between 'detectability' and 'preference' in the banana fiddler crab. In a one-choice experiment, we examined whether females were more likely to approach 'preferred' males (with large claws and fast waves) simulated by robotic crabs at various distances. In two, two-choice experiments, we presented females with a 'preferred' robotic crab and a 'non-preferred' robotic crab presented adjacently in one experiment, and opposite in the other. In the one-choice experiment, the females were less likely to approach the stimulus as the distance increased. Also, they approached all stimuli equally, regardless of distance. For the two choice experiments, females were significantly more likely to approach the preferred stimulus when their initial opportunity to view the options was from a closer distance, and when the test stimuli were close to each other. We show that preferred stimuli are not more detectable at a distance and females are more likely to exhibit a preference when they are able to directly compare stimuli within the same field of view.

USING MOLECULAR AND TRADITIONAL METHODS TO CHARACTERIZE THE MICROBIAL ECOLOGY OF SWALLOW AND MARTIN NESTS

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All bird nests are an extension of reproduction and parental care. While interacting with many biotic and abiotic factors, microorganisms can have a significant effect on the reproductive success of bird nests. Birds may influence the microbial presence by adding lining materials, like feathers, and manipulating the internal temperature. While an area of increasing study, the identities of microbes that are found on wild birds and in their nests are still mostly unknown, as are the ecological roles these microbes play. We characterise the microbial communities, using T-RFLP (terminal restriction fragment length polymorphism) methods, in lined and unlined nests of the welcome swallow (*Hirundo neoxena*) and fairy martin (*Petrochelidon ariel*). After collecting samples of nest material from both lined and unlined nests, we used traditional culturing and modern molecular methods to gain comprehensive characterisation of the microbe community and allow an estimation of the abundance and distribution of microbial species in the nests. Isolates from the microbial colonies were inoculated on chicken eggs, to determine if any of these species are capable of crossing the eggshell barrier, and are potentially pathogenic. We found numerous fungal and archaeal species in all nest types, however relatively few bacteria were found only in swallow nests.

BURNING LOVE: A CASE STUDY ON THE EFFECTS OF INTENSE BUSHFIRE ON SPECIES HYBRIDIZATION AND POPULATION GENETICS IN THE *LITORIA* COMPLEX

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The 2009 Victorian bushfires had a severe effect on landscapes throughout the Kinglake region. Importantly, this area is a contact zone for two hybridizing frog species in the *Litoria* complex. We analysed microsatellite data from various populations in the region to compare population genetic connectivity before and after this devastating event. Additionally, research into the mitochondrial DNA lineages in the *Litoria ewingii - Litoria paraewingii* species complex pre- and post-fire has revealed some changes in the structure of the contact zone potentially affecting hybridization. This ongoing project provides insights into how some faunal groups might cope with large-scale bushfire and the robustness of meta-populations facing major environmental challenges.

EFFECTS OF POLYUNSATURATED FATTY ACIDS ON SEXUAL TRAITS IN GUPPIES

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Analyses across different taxa reveal that males having faster, longer and higher number of sperm are predicted to maximize their success in sperm competition. Because sperm traits are very costly, only the fittest males are able to acquire and allocate the resources required for their expression. In this study, we experimentally manipulate diet quality (fatty acid and carotenoid levels) and quantity in the guppy (*Poecilia reticulata*), a livebearing freshwater fish. Specifically, we test for condition dependence in the expression of sperm traits (sperm swimming velocity, sperm viability, sperm number and sperm morphometry). Consistent with prior work we found a significant effect of diet quantity on the expression of sperm traits; diet-restricted males exhibited significant reductions in sperm velocity, sperm viability, sperm number and various components of sperm length than those fed ad libitum. Interestingly, we found only a significant effect of fatty acids on sperm viability. Contrary to our expectations, we found no significant effect of carotenoids or fatty acids on the expression of any other traits. Our results illustrate the sensitivity of sperm competitiveness of ejaculates from the treated males to their resource availability.

INTERSPECIFIC MATING BETWEEN *APIS CERANA* AND *A. MELLIFERA*

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The western honey bee, *Apis mellifera*, and the Asian hive bee, *A. cerana* have been allopatric for millions of years, but are similar in morphology and behaviour. During the last century the species have been brought into contact anthropogenically. In regions of sympatry, interspecific mating is of concern to commercial apiarists and bee conservationists, as artificial cross-insemination between *A. mellifera* and *A. cerana* yields inviable hybrid offspring. By analysing spermathecal contents with species-specific genetic markers we determined the frequency of interspecific mating of sympatric *A. mellifera* and *A. cerana* queens from Yunnan, China and Cairns, Australia. In China, 10% of *A. mellifera* queens mated with at least one *A. cerana* male. In contrast, no *A. cerana* queens had mated with *A. mellifera* males. While as yet there is no evidence of interspecific mating in Cairns, such mating is expected to increase as the invasive *A. cerana* population expands.

DESERT NOMADS: MOVEMENT OF BLACK SWANS (*CYGNUS ATRATUS*) IN ARID AUSTRALIA FOLLOWING LA NIÑA FLOODS

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Large numbers of Australian waterbirds use ephemeral water in the large arid interior of Australia, even though this resource is patchily distributed and stochastic in time, quality and quantity. How Australian waterbirds have adapted to this desert environment and are able to locate ephemeral water bodies in this vast landscape is a major unsolved puzzle of bird migration. After years of drought, two recent La Niña years caused heavy rainfalls and an influx of vast numbers of waterbirds into the arid interior of Australia. During this period, we deployed GPS satellite-transmitters on Black Swans (*Cygnus atratus*). Tracked individuals were very successful in locating new ephemeral water over an area of hundreds of kilometres. Individuals moved at night and several weather variables predicted their movements. With conditions in the interior deteriorating for waterbirds after the La Niña period ended, birds moved to areas with high rainfall and refugia in the interior. Our findings provide new insight into the navigation ecology of nomadic individuals and how Australian waterbirds have adapted to an environment which can rapidly change.

POPULATION GENETICS OF THE INVASIVE NORTHERN PACIFIC SEASTAR

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The northern Pacific seastar, *Asterias amurensis*, is a benthic marine predator, which has established several large invasive populations in Australian waters since its introduction to Hobart, Tasmania ~20 years ago. Recently, it has expanded its invasive range into the Tidal River estuary, Wilson's Promontory Marine National Park. Given the relatively recent nature of these introductions, Australian *A. amurensis* populations provide an exciting model to study contemporary evolutionary processes. In this talk, I will provide a summary of our research to date, where we address; the source, diversity and connectivity between invasive populations, whether these populations have undergone rapid evolutionary change and if they have the capacity for thermal adaptation and further range expansion. An understanding of *A. amurensis* population dynamics and evolutionary responses to novel environmental conditions, will not only inform management practices, but further our knowledge of the genetic basis of important processes in invasion ecology.

BRIDGING AND BUILDING: THE DYNAMICS OF COLLECTIVE CHAIN FORMATION IN GREEN TREE ANTS *OECOPHYLLA SMARAGDINA*

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Green tree ants, *Oecophylla* spp, are considered to represent the pinnacle of complex behaviour in social insects, demonstrated by their ability to form collective chains that can bridge gaps (bridging chains) and draw opposing substrates together in order to form nests (pulling chains). We know that collective choice in bridging chains is based on a single behavioural event (the probability that an individual will form a chain at a substrate edge) but we know little about pulling chains, how they may form or function and their relationships with bridging chains. Here we demonstrate how pulling chains can be induced in laboratory colonies, and demonstrate that the underlying dynamics appear remarkably similar to bridging chains. Flow rates in and out of both chain types appears constant and identical, bridging chains seem to morph seamlessly into pulling chains, and individual ants appear to treat others in a chain as simply being part of the substrate (being a social insect may well be very lonely!). We also use a method of marking individuals within pulling chains to provide the first descriptions of how these chains reduce their lengths in order to draw substrates together. Once again, individual simplicity underlies collective complexity and capability.

SPATIAL AND TEMPORAL PATTERNS OF POPULATION VISCOSITY IN A COOPERATIVE BREEDER

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For almost fifty years, the relationship between population viscosity and the level of cooperation in cooperatively breeding societies has been discussed. More recently, it has been recognised that ecological drivers may play an important role in the evolution of cooperation, where individuals living in less favourable habitats appear to be more cooperative. Some progress has been made towards understanding these complicated relationships through the use of inter-specific studies, but this approach is hampered by the need to control for phylogenetic relationships. Although an intraspecific approach circumvents this problem, few within species multi-site studies of cooperative breeders exist due to the need for intensive observation to understand relationships between group members. Here we present an intraspecific approach to this problem, using temporal, spatial and molecular data from an Australian cooperative breeder, the Chestnut-crowned babbler. We demonstrate how genetic networks can be used to visualise population viscosity and for the characterization of the genetic composition of social groups. We investigate how ecological drivers determine the relatedness microstructure, and in turn, affect the degree of population viscosity. Our results provide additional insight into the interaction between broad-scale ecology and the evolution of cooperation.

THE ECOLOGY OF NONGENETIC INHERITANCE IN THE NERIID FLY *TELOSTYLINUS ANGUSTICOLLIS*

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Nongenetic inheritance represents an ecologically significant yet poorly understood supplement to the traditional Mendelian model of inheritance. Theoretical work has suggested a role in evolution and adaptation, but few studies have examined environmental stimuli in detail. Investigators either focus on the underlying cellular mechanisms or contrast the effects of only two environments. In order to fully understand the role nongenetic inheritance plays in the generation of phenotypic diversity, it must be examined in a realistic ecological context. The Neriid fly *Telostylinus angusticollis* exhibits strongly condition dependent sexual dimorphism, mediated by the richness of the larval diet. Moreover, offspring of males raised on richer larval media tend to inherit the paternal high condition, regardless of their own larval diet quality. We adapted the nutritional geometry framework to investigate transgenerational effects of paternal diet. Parents were raised on 25 different diets ranging in both concentration and protein to carbohydrate ratio. Males from each diet were mated to standardised females, and offspring reared on either a rich or poor larval diet. Offspring emergence and size will be measured to create response surfaces for the effect of paternal diet on offspring phenotype. These results will shed light on the dietary ecology of nongenetic inheritance.

THE EVOLUTIONARY SIGNIFICANCE OF FACULTATIVE PARTHENOGENESIS IN THE AUSTRALIAN SPINY LEAF INSECT *EXTATOSOMA TIARATUM*

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The evolution of sexual reproduction is one of the most puzzling issues in biology, yet experimental tests of current theory are scarce. Facultative parthenogenesis, in which females reproduce in both modes, is especially common in stick insects (Phasmidae) and provides a suitable model system to study the evolutionary significance of sex. Such systems are helpful because they allow us to remove the confounding variables that are typically introduced into comparisons among different populations or species. Females of the spiny leaf insect *E. tiaratum* adjust their reproductive strategies according to the probability of mating. The selection pressures favouring facultative parthenogenesis are poorly understood, but several lines of evidence suggest that it may be an alternative strategy to overcome sperm limitation when mating is unlikely. Accordingly, we have designed experiments to investigate patterns of sperm usage and sexual signalling in *E. tiaratum*. These experiments will also allow us to compare the fitness consequences of sexual and asexual reproduction, and thus test explanations for the evolution of sex.

TEMPERATURE-DEPENDENT SEX DETERMINATION: CAN SEX-SPECIFIC AGE OF MATURITY EXPLAIN THE EVOLUTION OF SEX-DETERMINING MECHANISMS IN REPTILES?

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In reptiles, individual sex (male or female) is determined irreversibly during embryonic development based on either chromosomal complement (Genotypic Sex Determination, GSD) or incubation temperature (Temperature-dependent Sex Determination, TSD). These sex-determining mechanisms (SDMs) are evolutionarily labile across reptiles, suggesting that selective forces may play a role in explaining the occurrence of TSD vs. GSD. However, the adaptive explanation for variation in SDMs remains elusive despite decades of research. We propose a novel way in which simple biological traits of organisms may translate into selection for TSD or GSD. Specifically, if 1) incubation temperature influences annual juvenile survival, and 2) males and females mature at different ages, then the impact of temperature on individual fitness differs between the sexes and TSD is favoured. We test this prediction using data on SDM and sex-specific age of maturity across turtle species.

EXPLORING THE EVOLUTIONARY CONSEQUENCES OF CHEMICALLY DISRUPTED SEXUAL SELECTION USING AN AGENT BASED MODEL

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Endocrine-disrupting chemicals (EDCs) are pollutants that can disrupt the expression of male traits used by females to select mates. It has, therefore, been suggested that EDCs may ultimately cause the breakdown of systems of inter-sexual selection. We tested this hypothesis by building an agent-based model (ABM) of inter-sexual selection, inspired by guppies. In our model, a gene determines survival. Males signal their level of genetic quality via a signalling trait, which females use to select a mate with varying degrees of heritable preference. We allowed this system of sexual selection to become established and maintained in simulated populations. After this 'burn-in period', we introduced EDCs, which disrupt the nature of the relationship between the male's signalling trait and their genetic quality. We varied the strength of EDCs disruptive effects, the duration of EDC exposure and the genetic circumstances that lead to the initial evolution of female preference. In our model, EDCs led to a reduction in the level of female preference for male signalling traits. However, we also found that under some circumstances, such as long exposure to particularly disruptive chemicals, the viability of populations could also be compromised.

SONG AND NON-SONG VOCALISATIONS OF THE GREAT BOWERBIRD WITH AN EMPHASIS ON GEOGRAPHIC VARIATION.

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Geographic variation in birdsong has been described for many avian species, and should be considered when analysing the vocal repertoire of birds. In bird species with large ranges, individual populations and groups of individuals within that population will sometimes sing a modified version of the species-specific song (Westcott and Kroon, 2002). The Great Bowerbird, *Chlamydera nuchalis* has a large range in northern Australia with two distinct forms, an eastern subspecies (*C. n. orientalis*), and a western subspecies (*C. n. nuchalis*). This species of bowerbird has a large vocal repertoire, and is capable of mimicking sounds from the environment and the vocalizations of other species. The song and non-song vocalisations of the Great Bowerbird (*C. nuchalis*) were formally described and a comparison of the species advertisement call was made between the two isolated sites. This study may have implications for the validity of the named sub-species.

DARWIN MEETS LAMARCK AND MENDEL – EVOLUTIONARY EFFECTS OF TRANSGENERATIONAL PLASTICITY

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Non-genetic inheritance or Lamarckism was previously discredited. However, Darwin's ideas retrospectively benefited from Mendelian genetics, so evolutionary biology might also be strengthened by modern non-genetic inheritance. In a huge range of species, there is now burgeoning information on transmission of acquired characteristics, by mechanisms including cultural, epigenetics, transcriptome, proteome, mammalian milk, antibiotics in social animals, and gut flora adapted to certain food or pathogens. This transmission can increase survivorship by up to 3.4-fold in offspring exposed to their parent's microhabitat rather than an alternative microhabitat. This effect is much stronger than the fitness effects that are thought to be important in evolution – usually no more than a 1.1-fold increase in fitness. Moreover, this "transgenerational plasticity" can occur without variation of DNA base-sequences, so it is freed from many of the constraints of gene-based evolution. Recent reviews have urged population and evolutionary geneticists to consider the combined effect of genetic and non-genetic inheritance, and we are now able to do this, in two ways. Firstly we can assess fitness effects of microsatellite relatedness, social factors, and ecological factors. Secondly, we can model the long-term effects from interaction of genetic and non-genetic inheritance, often coming up with counterintuitive results.

RELIEF FOR A 'SPLITTING HEADACHE': RESOLVING A RAPID ADAPTIVE RADIATION IN THE ENDEMIC AUSTRALIAN *PSEUDOMYS* SPECIES GROUP (MURIDAE)

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Since at least the time of Darwin naturalists have been intrigued by the origin and diversity of species. Species radiations such as Darwin's finches are ideal systems with which to examine the underlying processes of evolution. Radiations can be driven by ecological processes (i.e. adaptive radiations) or non-ecological processes (i.e. non-adaptive radiations), and are characterised by species richness and/or ecological disparity between species. Adaptive radiations can prove challenging to resolve chronologically when lineage accumulation has occurred rapidly over a short temporal scale. Phylogenetic resolution can be impeded by evolutionary phenomena such as incomplete lineage sorting and horizontal gene transfer (introgressive hybridisation), and methodological issues like incomplete taxon sampling and genetic datasets lacking phylogenetic signal. The *Pseudomys* species group is a native group of Australian rodents, comprising approximately 45 species. Phylogenetic relationships among the group's constituent species have proven inherently difficult to resolve despite repeated attempts over the past two decades. Thus, the group offers an ideal system on which to test current approaches used to resolve phylogenetic relationships within recent and rapid adaptive radiations.

HOMOSEXUAL MEN SHOW REDUCED SENSITIVITY TO CUES OF ATTRACTIVENESS IN FEMALE FACES

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Several theories have been proposed to account for the evolution of homosexual behaviour in humans. These theories can be broadly divided into two groups: those that contend that the homosexual individual reproduces, attaining direct fitness benefits and those that explain the maintenance of homosexual individuals in the population via inclusive fitness, with the genes responsible for homosexuality being selected as a result of other consequences those genes have in heterosexual relatives. To help select between these theories we wanted to determine whether homosexual males, in spite of their sexual orientation, retained perceptual sensitivity to facial cues of female mate quality. Homosexual and heterosexual men and heterosexual women rated the attractiveness of male female faces that had been altered to manipulate configural and featural sexual dimorphism, symmetry, averageness. Homosexual, compared to heterosexual, men showed reduced effects of the manipulations on their attractiveness ratings to female faces, but the two groups of men did not differ in their sensitivity to the same cues in male faces. The selective loss of sensitivity to cues of attractiveness in female faces only is consistent with homosexuality evolving as an alternative mating strategy.

REDUCED GENETIC VARIANCE AMONG HIGH FITNESS INDIVIDUALS: INFERRING STABILIZING SELECTION ON MALE SEXUAL DISPLAYS IN *DROSOPHILA SERRATA*

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Directional selection is prevalent in nature yet phenotypes tend to remain relatively constant, suggesting a limit to trait evolution. However, the genetic basis of this limit is unresolved. Given widespread pleiotropy, opposing selection on a trait of interest may arise from the effects of the underlying alleles on other traits under selection, generating net stabilizing selection on trait genetic variance. These pleiotropic costs of trait exaggeration may arise through any number of other traits, making them hard to detect in phenotypic analyses. Stabilizing selection can be inferred, however, if trait genetic variance is greater among low as compared to high fitness individuals. We apply this recently suggested approach to a suite of cuticular hydrocarbons (CHCs) in *Drosophila serrata*. Despite strong directional sexual selection on these traits, CHC genetic variance differed between high and low fitness individuals and was greater among the low fitness males for seven of eight CHCs, significantly more than would be expected by chance. Univariate tests of a difference in genetic variance were non-significant but likely have low power. Our results suggest that further CHC exaggeration in *D. serrata* in response to sexual selection is limited by pleiotropic costs mediated through other traits.

THE EVOLUTION OF POLYSPECIFIC AGGREGATION

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The phenomenon of mixed age and species aggregations in aposematic Paropsine beetle larvae has been documented for decades, but its evolutionary significance is unknown. The adults and larvae of two species of leaf beetles - *Paropsis atomaria* and *Paropsisterna variicollis* - often feed and oviposit on the same *Eucalyptus* trees. Larvae of both species have contrasting colour patterns of yellow and black, which vary according to instar. Defensive behaviours such as rearing and regurgitation are similar in both species. We surveyed larval aggregations in the field and found that later instars occurred in smaller groups, compared with earlier instars. Polyspecific aggregations were significantly larger than monospecific aggregations at later instars. Also, *Paropsisterna variicollis* larvae occurred in significantly larger groups than those of *Paropsis atomaria*. Field experiments investigated the implications of aggregations with mixed colour patterns by manipulating aggregations in the field and scoring survival and behaviour over five days. Gregarious behaviour was correlated with survival in both species, regardless of aggregation type. This suggests that polyspecific aggregations have evolved to increase survival, despite the potentially negative effect of confusing signals from mixed groups.

SURVIVING IN SYMPATRY: PARAGENITAL DIVERGENCE AND SEXUAL MIMICRY BETWEEN A PAIR OF TRAUMATICALLY INSEMINATING PLANT BUGS

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Reproductive interactions between species can carry significant costs (e.g. wasted time, energy and gametes). In traumatically inseminating insects, mating costs may be intensified, with indiscriminate male mating behaviour and damaging genitalia potentially leading to damage or death. When closely related traumatically inseminating species are sympatric, we predict selection should favour the rapid evolution of reproductive isolation. Here we report on a cryptic species of traumatically inseminating plant bug, *Coridromius taravao*, living sympatrically with its sister species, *C. tahitiensis,* in French Polynesia. Despite their sister-species relationship, they exhibit striking differences in reproductive morphology, with females of each species stabbed and inseminated through different parts of their abdomens. Furthermore, *C. tahitiensis* is sexually dimorphic in colouration and vestiture, while both sexes of *C. taravao* share the *C. tahitiensis* male expression of these traits. These findings support a role for 1) reproductive character divergence and 2) interspecies sexual mimicry, in limiting interspecific mating brought about by indiscriminate male mating behaviour.

TRACING THE ORIGINS OF ONE- AND TWO-LEAF CAPE TULIPS IN AUSTRALIA

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One- and two-leaf Cape tulips (*Moraea flaccida* and *M. miniata*, respectively) originate from South Africa and are invasive across most of southern Australia. They are unpalatable and toxic to livestock, and infestation in pasture can reduce carrying capacity by up to 50%. The rust fungus *Puccinia moraea*, endemic to South Africa, is a promising biological control agent for both species. Previous research has shown that strict compatibility between the rust and plant genotypes will be required before an effective biocontrol solution can be developed. In this study, we determined the level of genetic diversity in Australian populations of these two *Moraea* species and populations collected from South Africa using simple sequence repeat (SSR) and the trnL (UAA) – trnF (GAA) region (1,018bp) of the chloroplast DNA as markers. Results were analysed to infer the most likely South African origins of the Australian populations that will facilitate sampling of compatible, pathogenic rust accessions for future development as biocontrol agents.

TRAIT SHIFTS CORRELATE WITH ENVIRONMENTAL CHANGE: THE EVOLUTIONARY RADIATION OF *TRIODIA*

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The global expansion of arid habitats since the mid-Miocene has contributed to major changes in species distributions and rates of diversification. How and why some lineages are capable of adapting to new environments is of major interest in ecology and evolution because it is such shifts that have allowed the continuance of lineages and the diversification of life. Endemic spinifex grasses of tribe Triodieae (*Triodia*, *Symplectrodia* and *Monodia*), are a key component of the flora of the Australian arid, semi-arid, and seasonally arid (monsoonal) zones. Here we show multiple shifts in a complex of leaf traits associated with photosynthesis and conservation of water. Timing of trait shifts and radiations of the major lineages of *Triodia* correlate with Pliocene climate change. We discuss the relationship between trait change and niche shifts in *Triodia*.

TRIGGERS OF STARTLE DISPLAY IN AN ALPINE KATYDID

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Animals that are cryptic but can flash bright patches of colour can both avoid detection and/or deter predators by startling them. This study focused on the startle display of the mountain katydid (*Acripeza reticulata*) an Australian alpine specialist. Concealed beneath their wings, males and females of this large katydid exhibit remarkable and striking blue, red and black striping on their abdomens. Our aim was to determine what types of stimuli provoke the katydid to reveal its brightly coloured abdomen. Using several invasive (e.g. poking) and non-invasive (e.g. shadowing) treatments we found that katydids showed the greatest reaction to our invasive treatments, apparently requiring tactile stimuli to reveal their startle colours. This result provides an interesting basis with which to test further hypotheses to explain the evolution of warning colours that require their owner to be attacked to be revealed.

EVOLUTION OF THE THERMAL NICHE AND ITS IMPACT ON BIODIVERSITY PATTERNS IN SEAWEEDS

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The thermal niche of seaweed species is known to have a strong influence on their distribution ranges. In turn, geographical distributions determine patterns of species richness across the globe. But the thermal niche is not a static feature over evolutionary timescales. Our goal is to incorporate the evolutionary dynamics of thermal niches into assessments of global patterns of species richness. Using evolutionary modelling approaches in a phylogenetic context for three seaweed genera, we show that the thermal niche evolves at different rates in different lineages, and illustrate relationships between microhabitat preferences and rates of thermal niche evolution. We show that niche evolution promotes the diversification of taxa by different mechanisms and reveal its impact on global diversity patterns. In summary, our results show that the thermal niche evolves in a highly taxon-specific manner and that it has a clear impact on the species richness patterns of those taxa.

DECONSTRUCT THE SOUP—CUTICULAR HYDROCARBON SIGNALS OF AUSTRALIAN MEAT ANTS

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The capacity to distinguish nestmates from others is critically important for the maintenance and survival of social insect colonies. It is widely accepted that workers use cuticular hydrocarbons (CHC) to distinguish between classes of individuals. Typically, investigations of nestmate recognition report on the individuals' response by measuring the level of aggression, and on the CHC profile of the entire individual. We examined, in Australian meat ant (*Iridomyrmex purpureus*) workers, whether there was an association between where an opposing individual worker directed its antennation behaviour and any CHC differences of different body parts. We discovered that more than 90% of all antennation are directed to antennae and feet, with workers directing more attention to the feet when they encounter nestmates and to the antennae of non-nestmates. Chemical analyses (GC-FID and GC-MS) of CHC on the antennae, head, feet and abdomen of ants from six colonies revealed striking differences between each body part. These differences are due to the concentration rather than type of chemicals, and between-colony CHC profiles vary according to the body part. These results suggest that *I. purpureus* decorate different body parts with different chemical components from various glands, and that these chemicals most likely convey different signals.

WHICH SNOW SKINKS LIKE IT HOT?

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Shifting climates are set to affect a diverse array of species, with many species predicted to become extinct. The rapid rate of climate change is predicted to exceed the speed of biological response, such as migration or evolutionary change. The majority of predictions of shifts in species distributions (including local extinction) are based on species distribution models (SDM). While these models provide crucial information, they frequently fail to take into account evolutionary and ecological processes, particularly realistic behavioural and physiological responses to climate variation (including variation between populations and species). Here we firstly present correlative models that predict drastic range reductions of Tasmania's alpine snow skinks in the next 50 years with concurrent increases in the range of lowland species. We then integrate a 15 year field study with laboratory experiments to demonstrate the effects of climate on key biological processes and assess the potential of behavioural and physiological compensation to buffer environmental variation in alpine and lowland snow skinks. We finally use this information to parameterise an evolutionary simulation model that provides matching predictions to the SDM models of alpine species extinction because of the evolutionary trap caused by divergent reproductive and demographic processes in alpine and lowland species.

SEXUAL SELECTION AND THE EVOLUTIONARY IMPLICATIONS OF MULTIPLE INTRODUCTIONS IN AN INVASIVE LIZARD

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Recent research suggests that multiple introductions of distinct lineages are common in invasive species. However, the impact of admixture on the fitness of introduced populations, and consequently its contribution to their evolutionary potential, has received little attention. Sexual selection is important within this context because it is fundamental to the maintenance of genetic variation, reproductive output, and hence population growth. Furthermore, sexual selection is predicted to be highly context-dependent. For example, variance in genetic diversity resulting from admixture should influence the mating strategies of males and females, and thus, regulate population dynamics and accelerate/impede the introgression of genotypes. Here we show that human introductions of wall lizards (*Podarcis muralis*) into the UK have brought into contact genetically and phenotypically distinct lineages. This has significant implications for mating behaviours employed by individuals. We show that females do not discriminate between males of different origins despite large differences in male morphology, pheromone profiles, and behavioural dominance between clades. Despite this, paternity is highly assortative. This could be due to male mate choice or male-male competition that results in assortative paternity in the absence of male choice *per se*. We discuss how these results could influence the evolutionary consequences of secondary contact.

THE COEVOLUTION OF IRIDESCENT VISUAL SIGNALS AND THEIR BEHAVIOURAL PRESENTATION

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Sensory drive theory contends that animal signalling systems should evolve (within constraints) to maximise transmission between senders and intended receivers, while minimising transmission to unintended receivers. Iridescent structural colours present special signalling opportunities for this owing to their highly directional properties. Here we used the butterfly *Hypolimnas bolina* to test the hypothesis that the design and behavioural presentation of iridescent signals should coevolve to maximise signal efficacy while minimizing eavesdropping. We used reflectance spectrometry to characterize signal dynamics, and high-speed video to quantify male flight dynamics. These data were combined to generate predictions as to where courting males should position themselves to maximise signal conspicuousness to females, which we tested by tracking males during courtship using high-speed video. Our results show that courting males position themselves in a way that simultaneously maximises signal brightness and area, as perceived by females, while minimizing the duration of the UV flash during flight. These results suggest that male signal design and display coevolved to maximise conspicuousness (hence, attractiveness) to females, and imply a role for temporal signal features in mate attractiveness. The highly limited-view nature of this signal suggests that its conspicuousness would be otherwise reduced, thereby minimising transmission to eavesdroppers.

EVOLUTION OF COMMUNICATION: A COMPARISON ACROSS THE ANTENNAE OF BEHAVIOURALLY DIVERSE NATIVE BEES

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There is extraordinary morphological variation in the antennae of insects. This diversity is well used taxonomically, but the selection pressures responsible for the *evolution* of this diversity are poorly understood. Antennae detect chemical signals from inter and intra-specific sources and are vital for identifying resources, mates and sources of danger. Given this functional importance, antennal morphology must be subject to significant selective pressures, to increase both functionality and account for the extreme variety of morphology. My research will investigate these selection pressures using a collection of Australian bees as model taxa. Native Australian bees are morphologically and behaviourally diverse, and both their dispersal patterns and phylogeny within Australia are reasonably well understood. The social organizations of native bees range from solitary, semi-social, to eusocial and some species are social parasites of other bee species. I shall account for the morphological variation in antennal diversity by examining relationships between these behavioural states, dispersal patterns, phylogeny and descriptions of gross and fine antennal morphology.

MALE COLOUR MORPHS OF THE TAWNY DRAGON LIZARD *CTENOPHORUS DECRESII*, A CASE OF ALTERNATIVE MATING STRATEGIES?

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Colour polymorphism is the coexistence of two or more discrete colour forms within an interbreeding population and is observed in a wide range of taxa. Colour morphs often differ in suites of associated morphological, physiological and/or behavioural traits frequently corresponding to different life-history strategies, particularly mating tactics. Different life-history strategies can account for the maintenance of polymorphisms within a population, with each strategy having equal fitness over time or a fitness advantage when rare. We are investigating differences among colour morphs of the Australian tawny dragon lizard *Ctenophorus decresii.* Within populations in the Flinders Ranges there are four distinct male throat colour morphs: orange, yellow, grey and orange/yellow. Male morphs do not differ in morphology, bite force or microhabitat preferences. However, morphs show differences in territory size, territorial behavioural and predator response suggesting morph-specific mating strategies.

THE EVOLUTION OF COOPERATIVE COMMUNICATION IN ANT-BUTTERFLY ASSOCIATIONS

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Science magazine listed 'How did cooperative behaviour evolve?' as one of the big questions of the next quarter century. Communication is a key factor in maintaining cooperation systems, and is mediated by chemical signalling in mutualistic relationships of insects. Although there have been several investigations of the communication systems of ant-butterfly associations the primary focus has been at the genetic, cellular or molecular level of chemical signalling systems. In contrast, there has been little to the considerable variation of sensory receptors of both ants and butterfly larvae. In particular, the role of secondary setae of butterfly larvae in facilitating symbioses with ants and whether these receptor organs have shaped the evolution of mutualism are unknown. We will conduct comprehensive morphological research on larvae of different species of the genus *Ogyris* (Papilionoidea: Lycaenidae), which shows a high degree of variability in ant association, to gain insight in the evolution of the various types of larval setae and define their role as receptor organs. The results of this comparative approach will be aligned with chemical analyses and behavioural studies to understand the evolution of chemical communication in mutualistic ant-butterfly associations.

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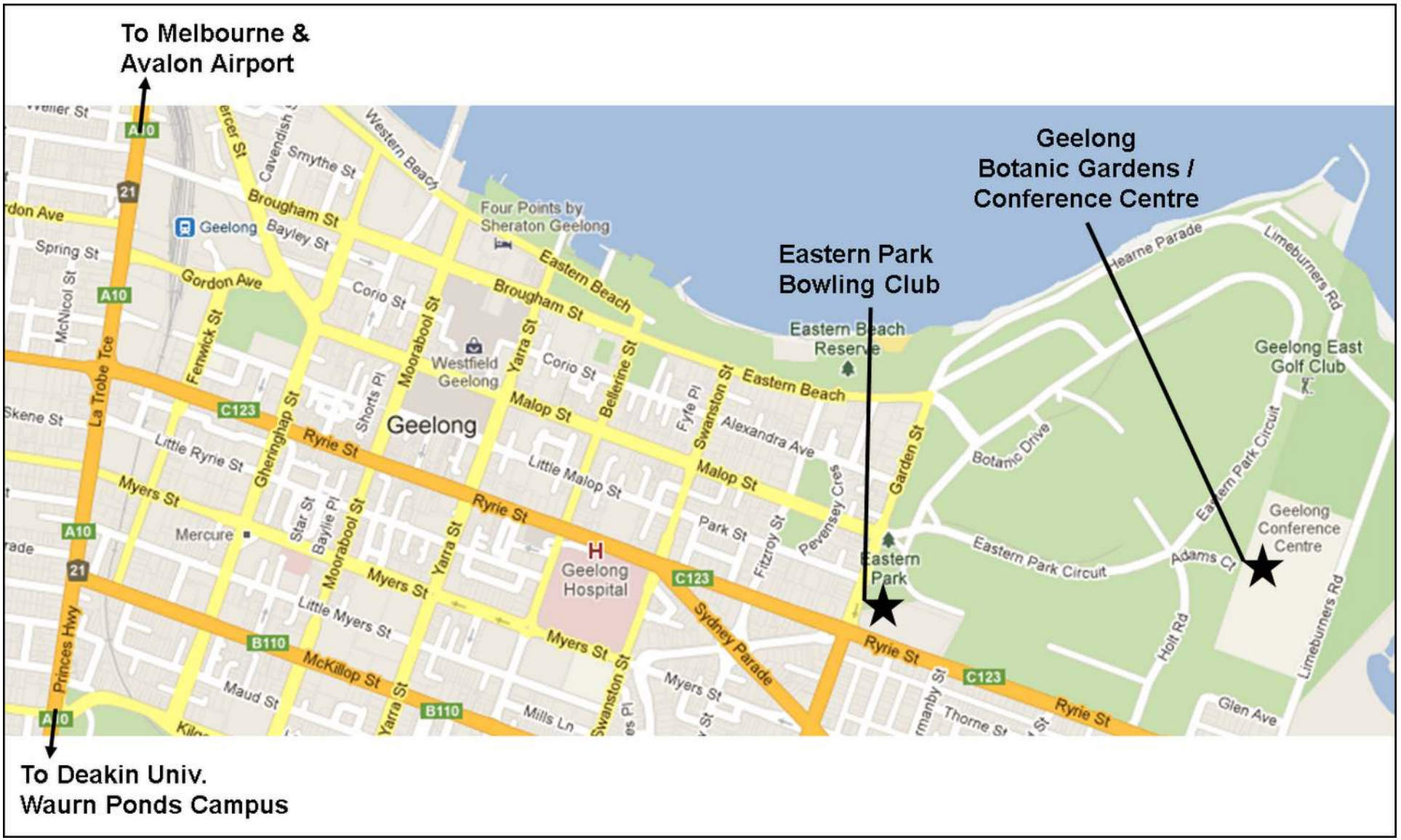

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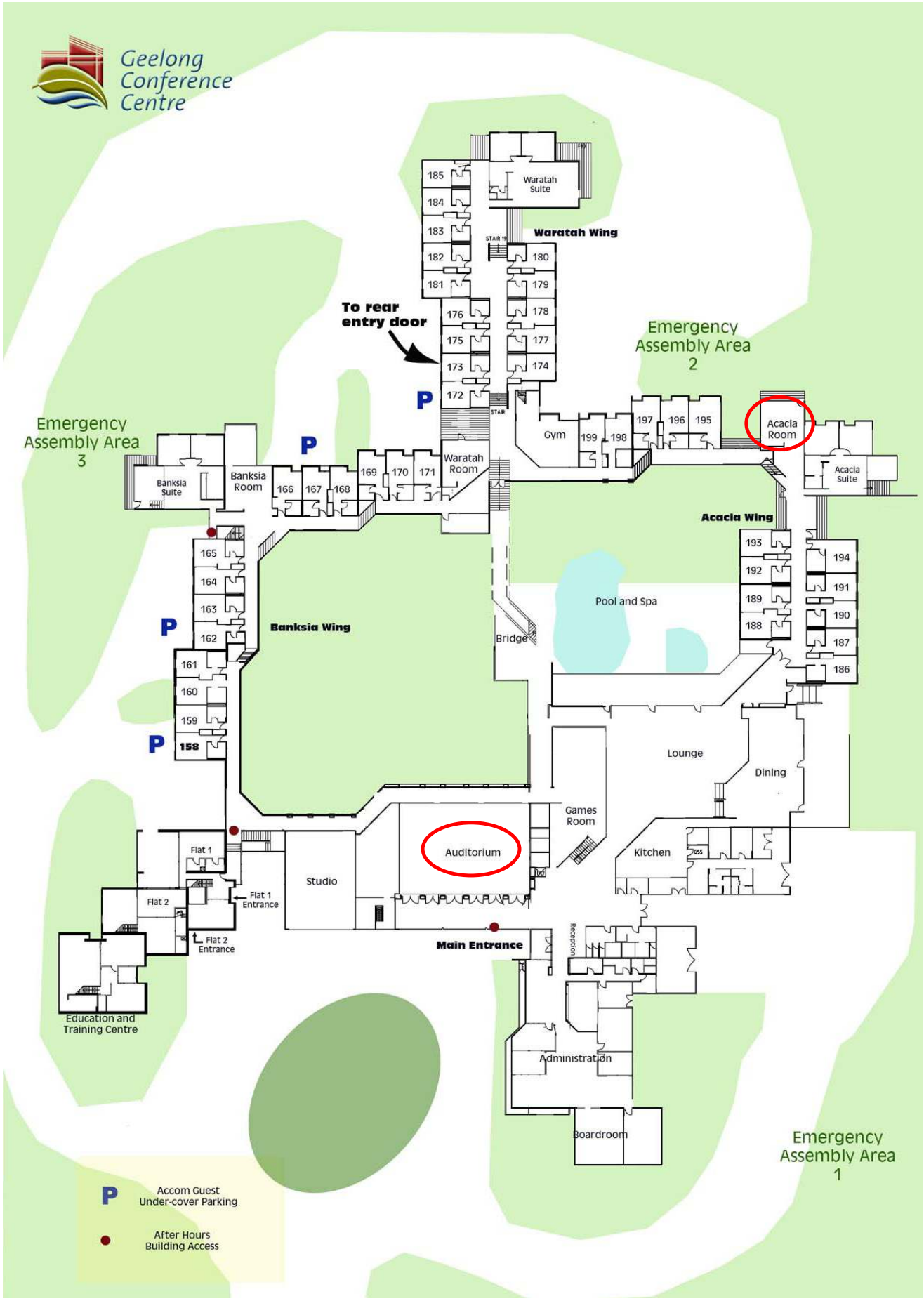
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Lounge
Dining
Games Room
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